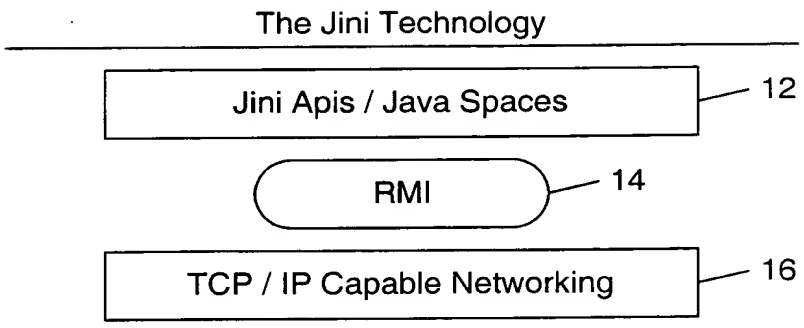


Fig. 1
(Prior Art)

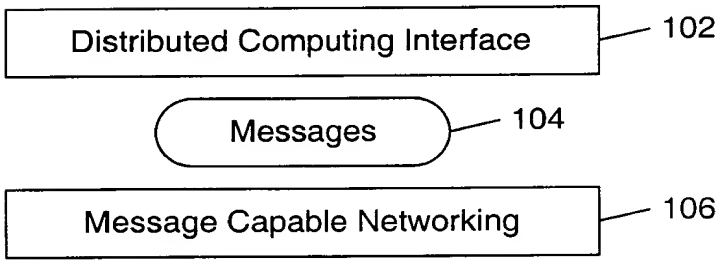


Fig. 2

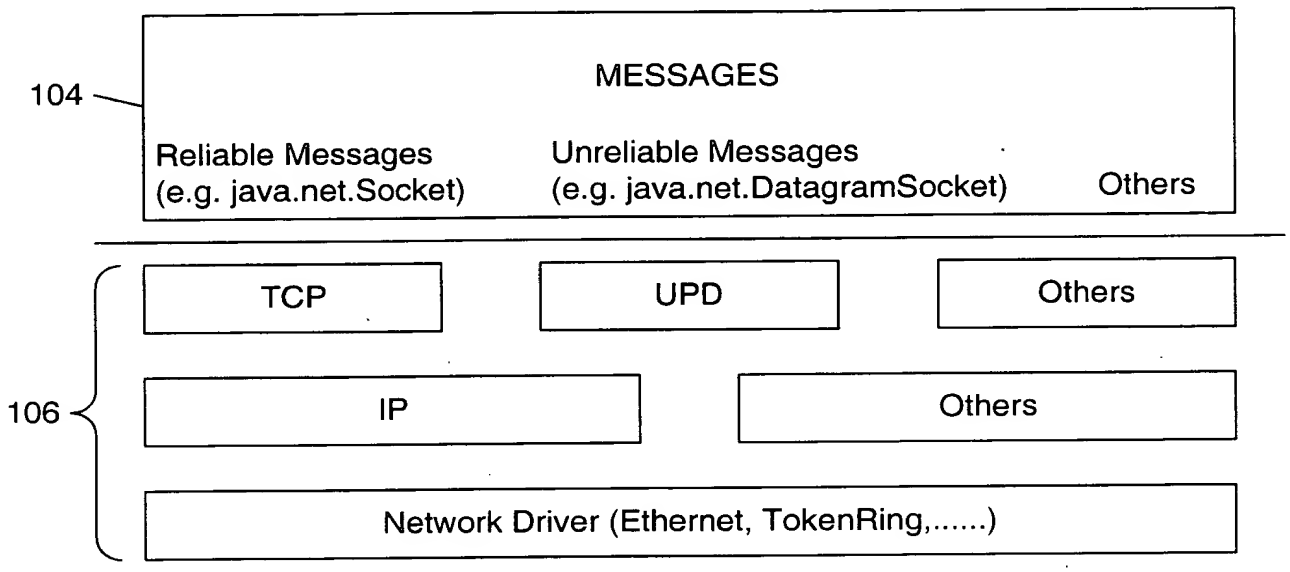

104
MESSAGES
Reliable Messages
(e.g. java.net.Socket)
Unreliable Messages
(e.g. java.net.DatagramSocket)
Others
106
TCP
UPD
Others
IP
Others
Network Driver (Ethernet, TokenRing,.....)

Fig. 3

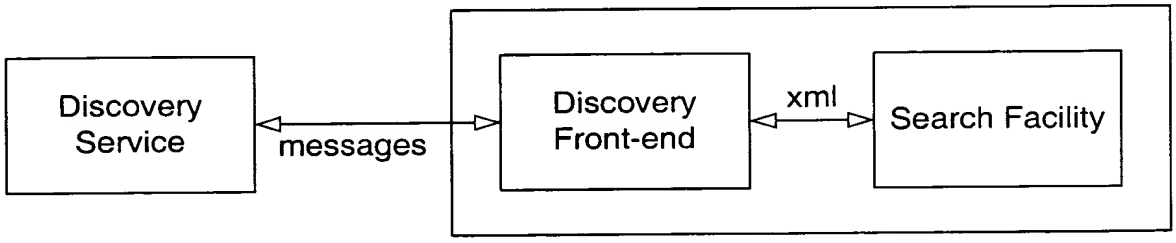

Discovery
Service
messages
Discovery
Front-end
xml
Search Facility

Fig. 4

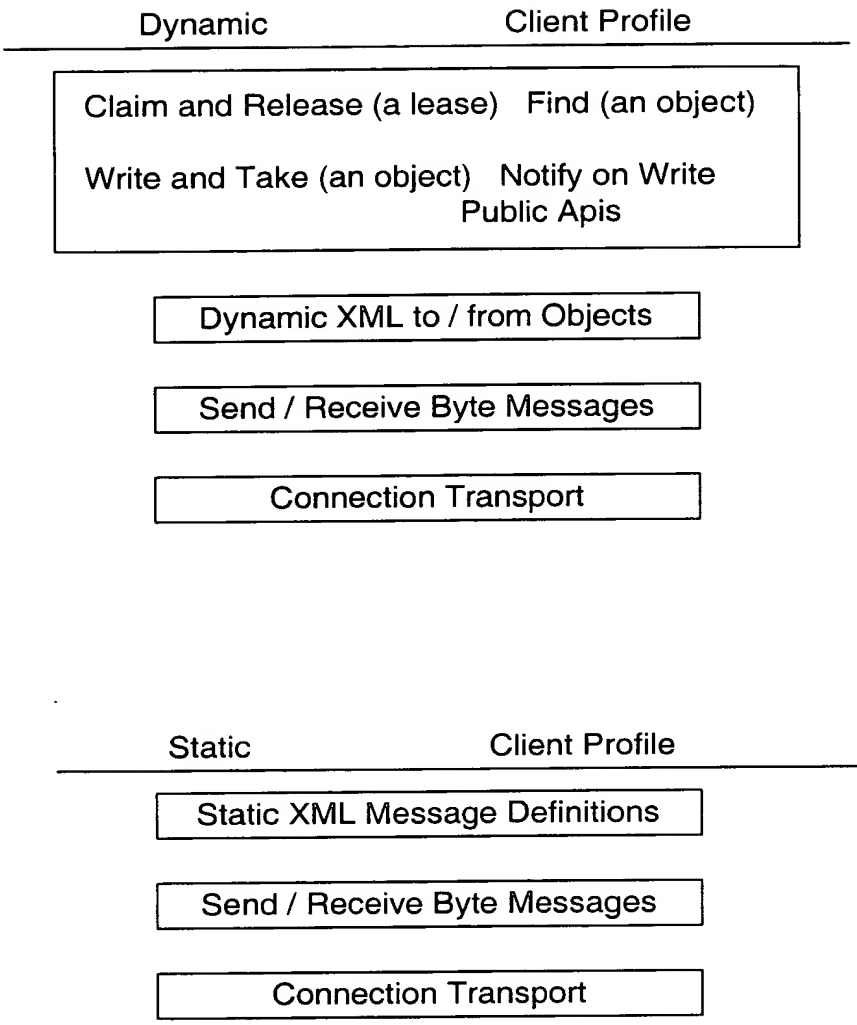

Dynamic
Client Profile
Claim and Release (a lease)
Find (an object)
Write and Take (an object)
Notify on Write
Public Apis
Dynamic XML to / from Objects
Send / Receive Byte Messages
Connection Transport
Static
Client Profile
Static XML Message Definitions
Send / Receive Byte Messages
Connection Transport

Fig. 5

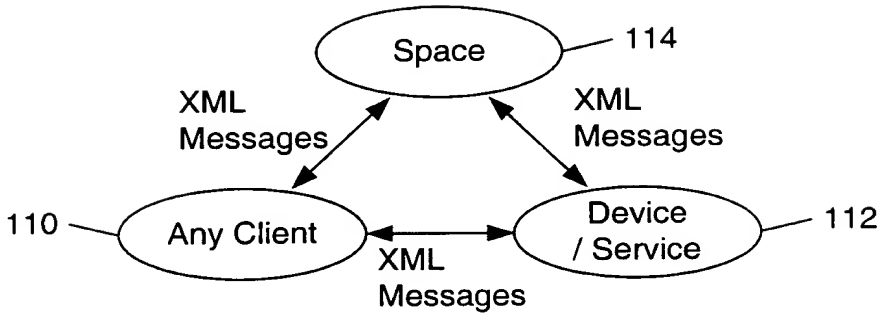

Space
114
XML
Messages
XML
Messages
110
Any Client
Device
/ Service
112
XML
Messages

Fig. 6

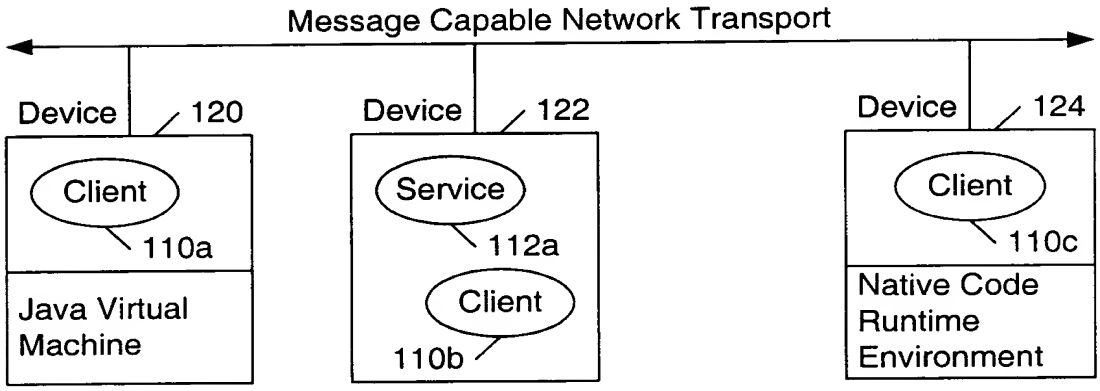

Message Capable Network Transport
Device
120
Client
110a
Java Virtual
Machine
Device
122
Service
112a
Client
110b
Device
124
Client
110c
Native Code
Runtime
Environment

Fig. 7

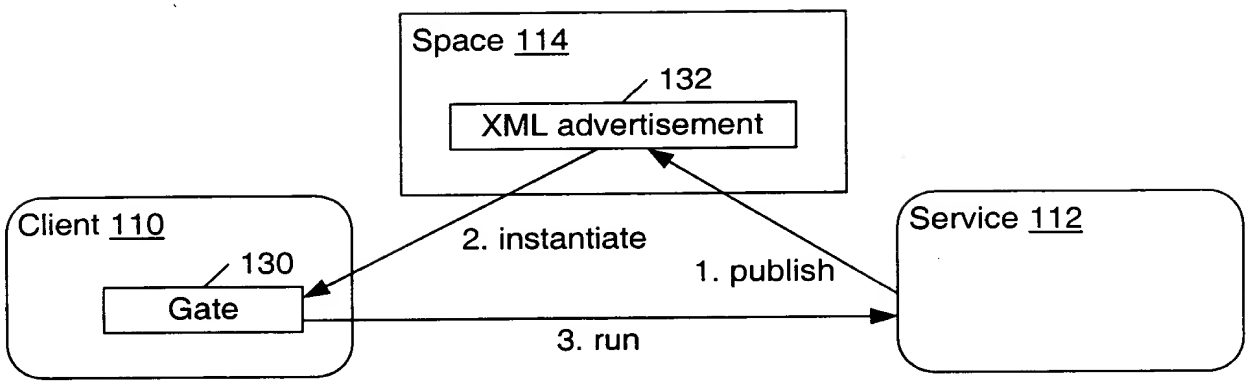

Space 114
132
XML advertisement
Client 110
130
Gate
2. instantiate
1. publish
3. run
Service 112

Fig. 8

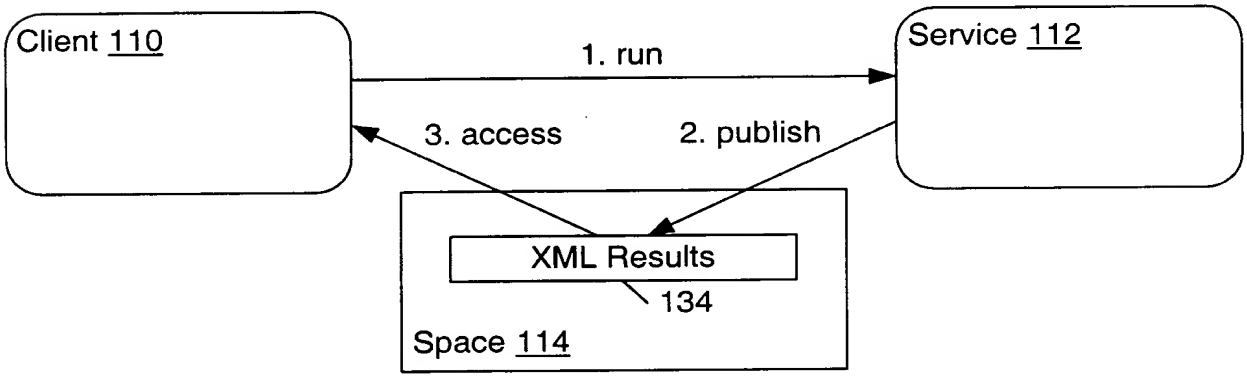

Client 110
1. run
Service 112
3. access
2. publish
XML Results
134
Space 114

Fig. 9

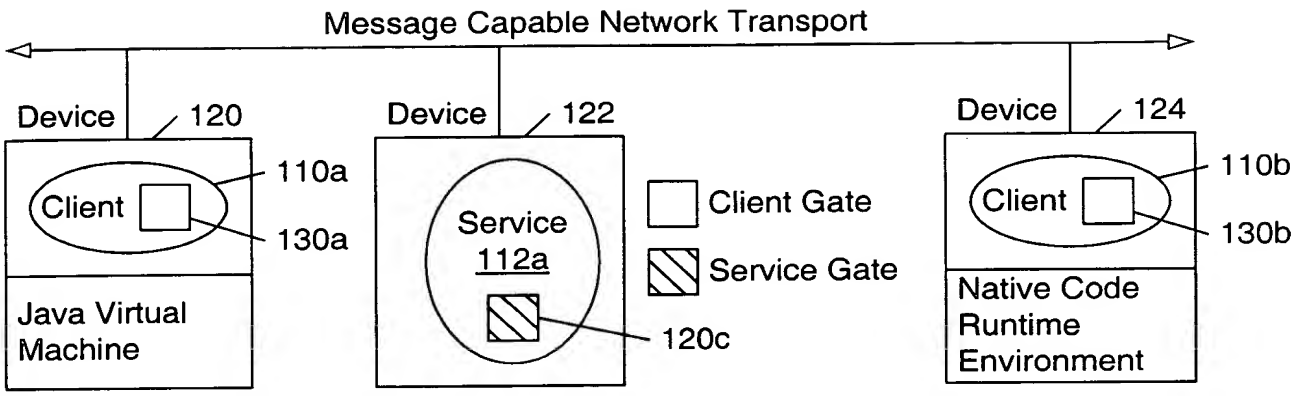


Fig. 10a

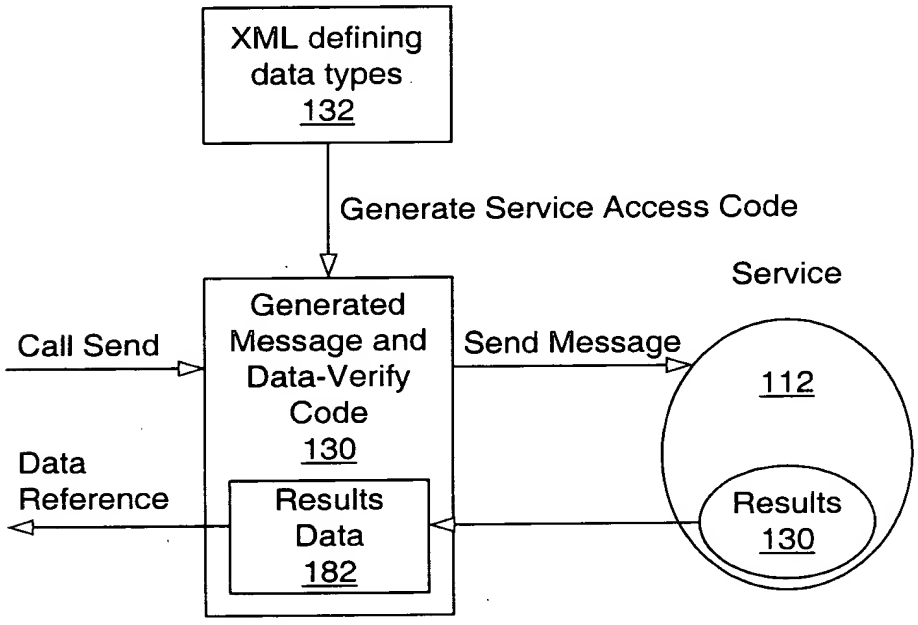


Fig. 10b

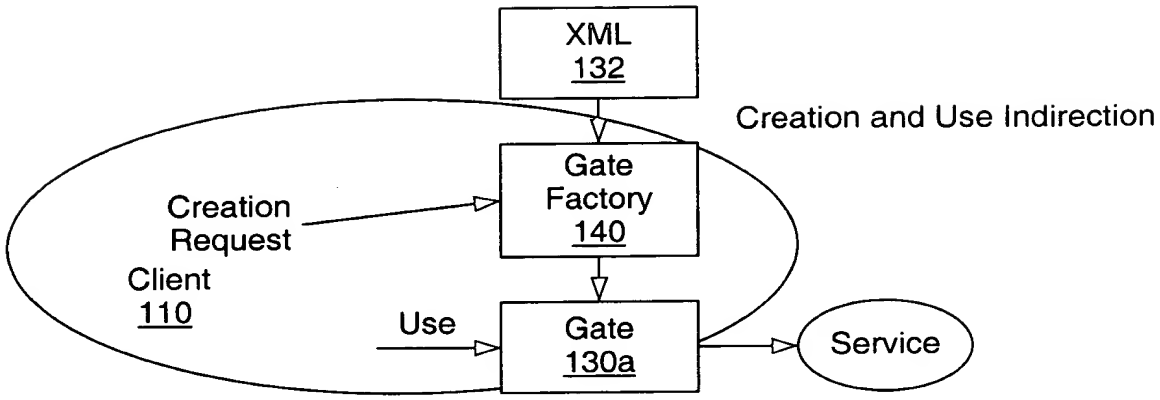


Fig. 11a

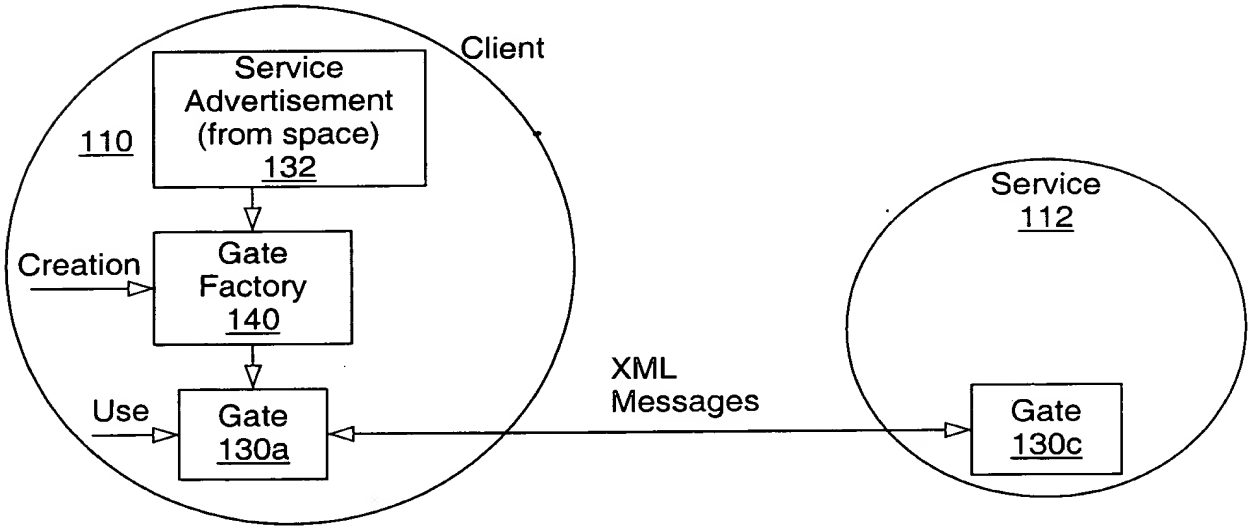


Fig. 11b

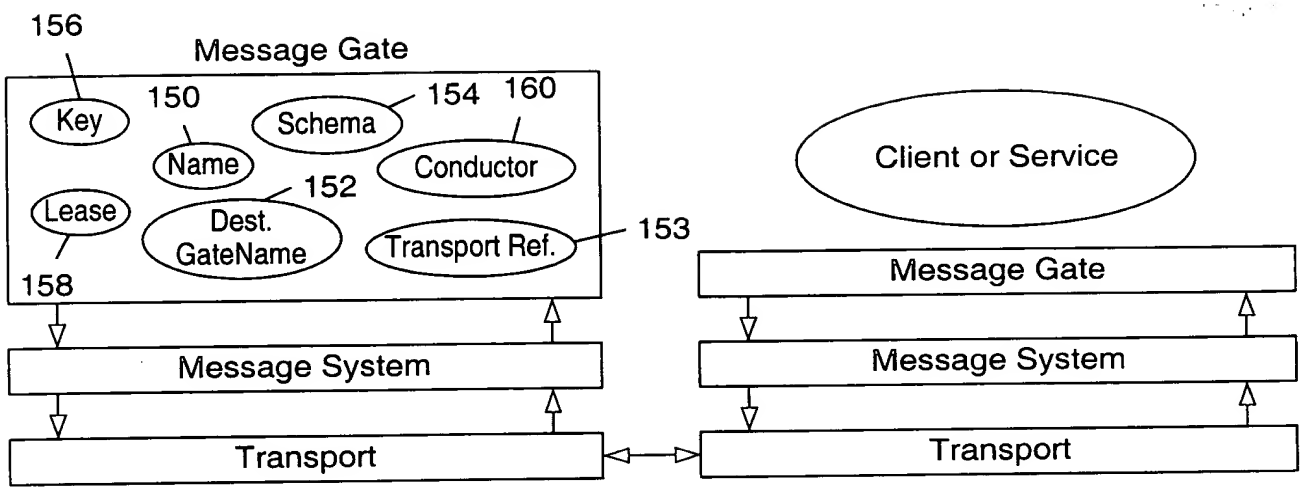

156
Message Gate
150
154
160
Key
Schema
Name
Conductor
152
Lease
Dest.
GateName
Transport Ref.
153
158
Client or Service
Message Gate
Message System
Transport
Message System
Transport

Fig. 12

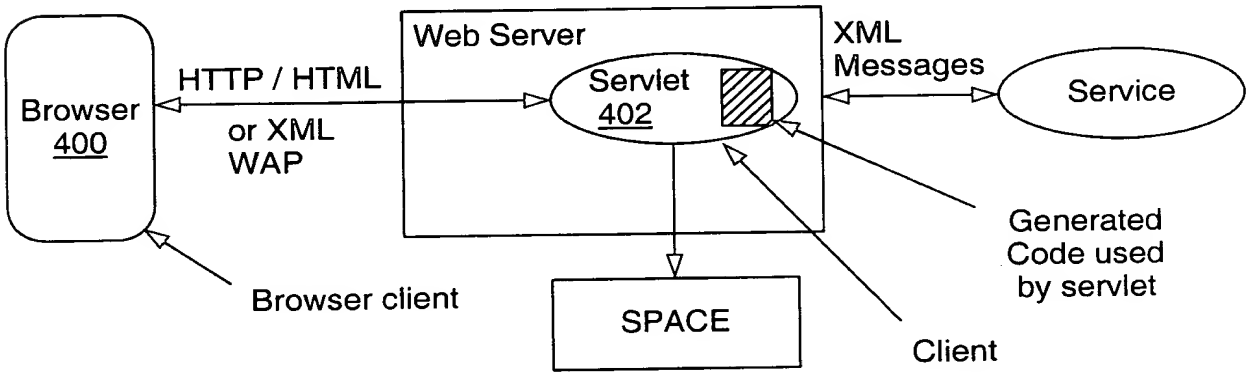

Web Server
XML
Messages
Service
HTTP / HTML
Servlet
402
Browser
400
or XML
WAP
Generated
Code used
by servlet
Browser client
SPACE
Client

Fig. 13

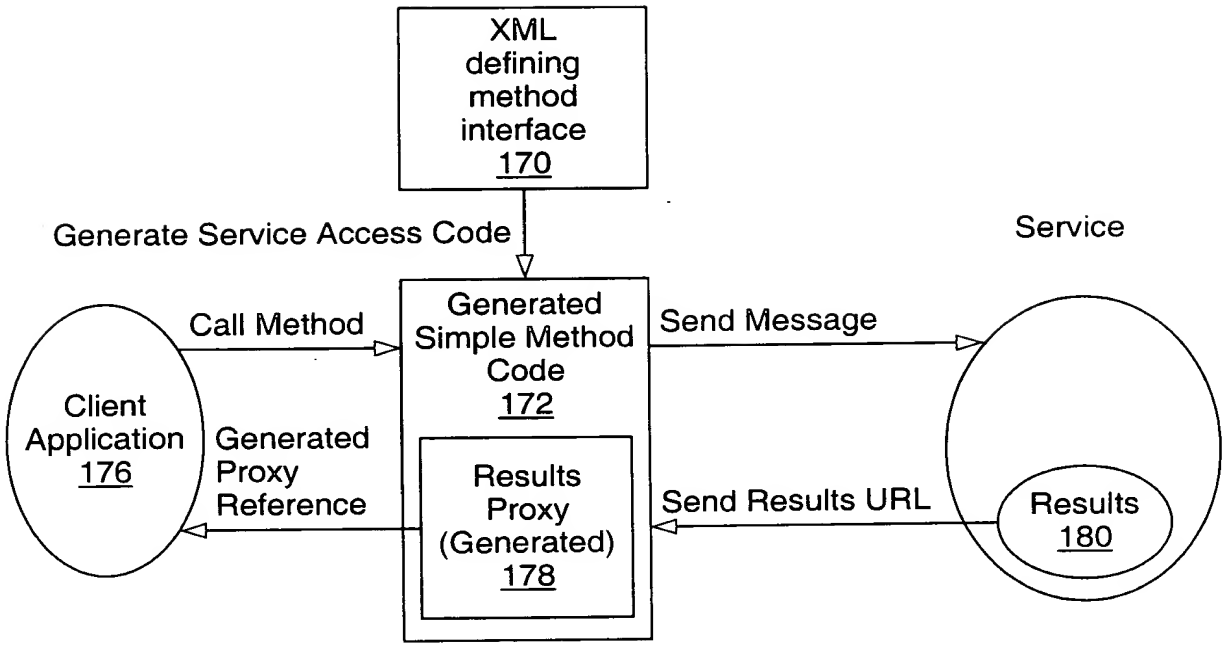

XML defining method interface 170
Generate Service Access Code
Service
Call Method
Generated Simple Method Code 172
Send Message
Client Application 176
Generated Proxy Reference
Results Proxy (Generated) 178
Send Results URL
Results 180

Fig. 14

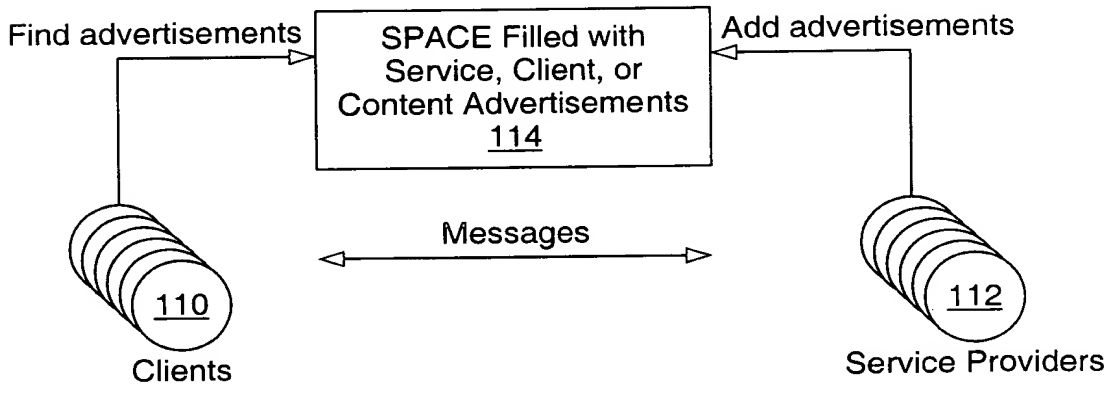

Find advertisements
SPACE Filled with Service, Client, or Content Advertisements 114
Add advertisements
Messages
110
Clients
112
Service Providers

Fig. 15

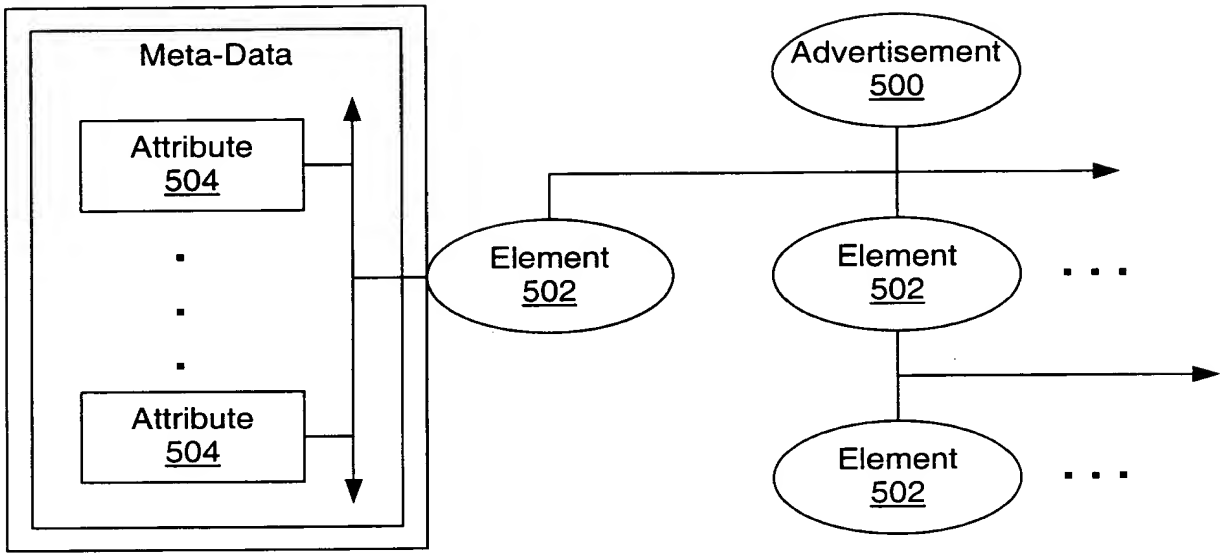

Meta-Data
Attribute
504
Attribute
504
Advertisement
500
Element
502
Element
502
Element
502

Fig. 16

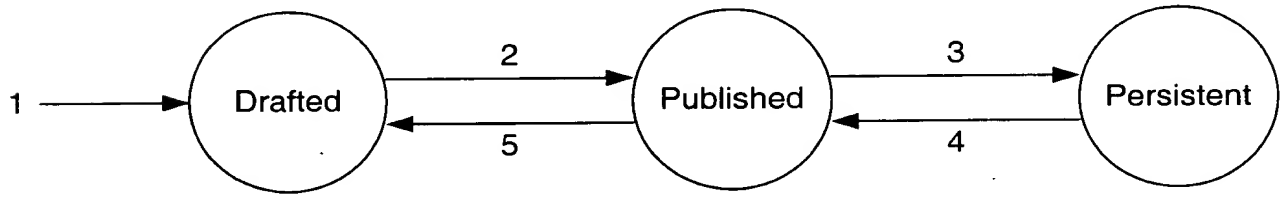

1
Drafted
2
5
Published
3
4
Persistent

Fig. 17

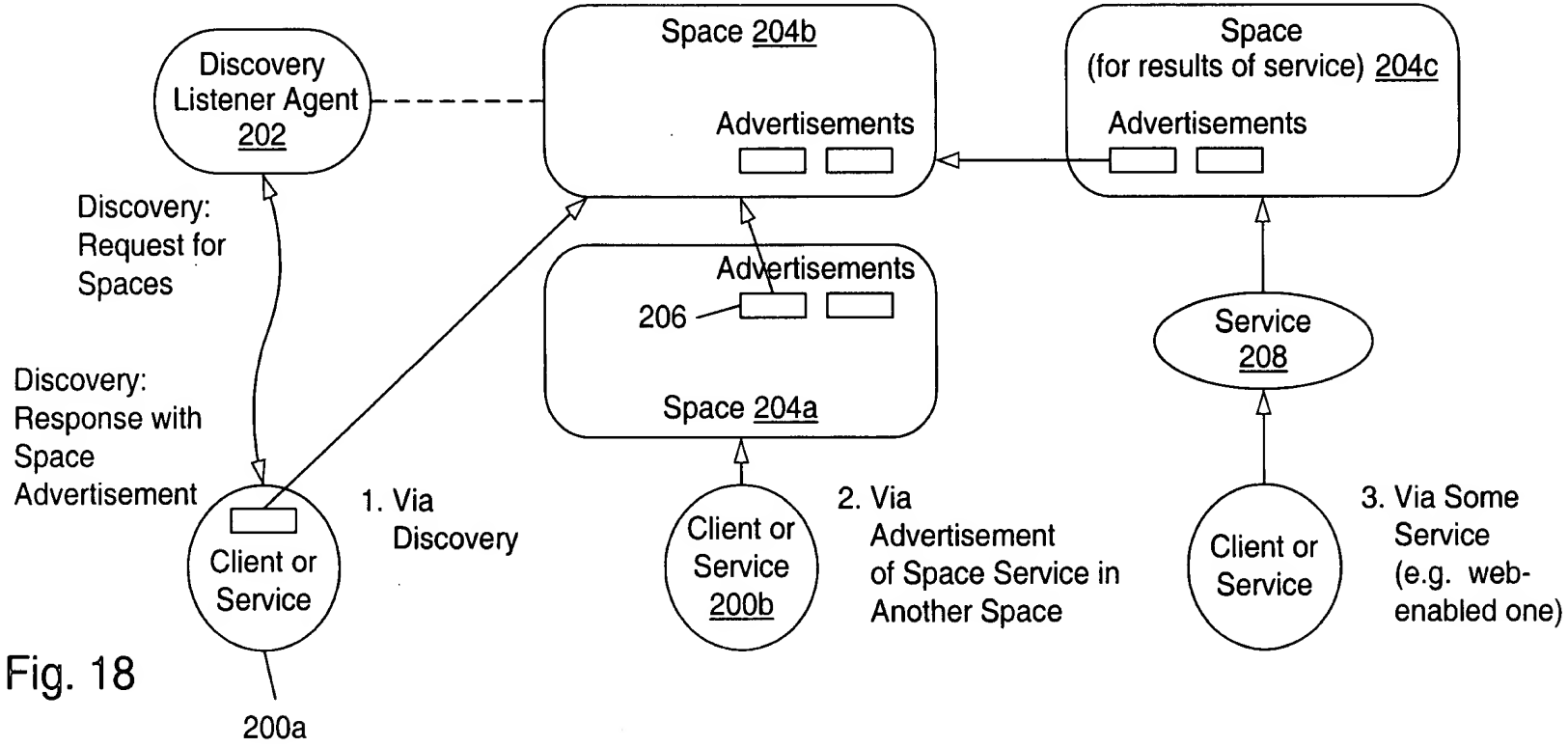

Space 204b
Advertisements
Space
(for results of service) 204c
Advertisements
Discovery
Listener Agent
202
Discovery:
Request for
Spaces
Discovery:
Response with
Space
Advertisement
Advertisements
206
Space 204a
Service
208
1. Via
Discovery
Client or
Service
Client or
Service
200b
2. Via
Advertisement
of Space Service in
Another Space
Client or
Service
3. Via Some
Service
(e.g. web-
enabled one)
200a

Fig. 18

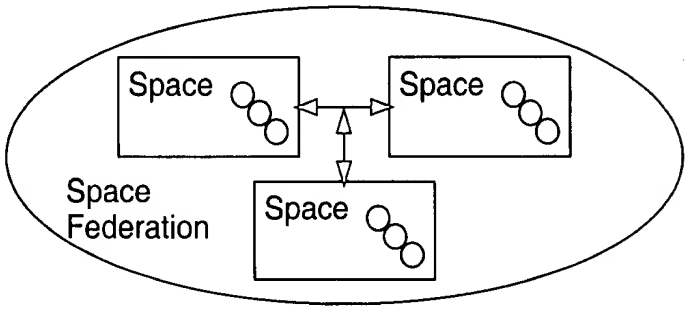

Space
Space
Space
Federation
Space

Fig. 19

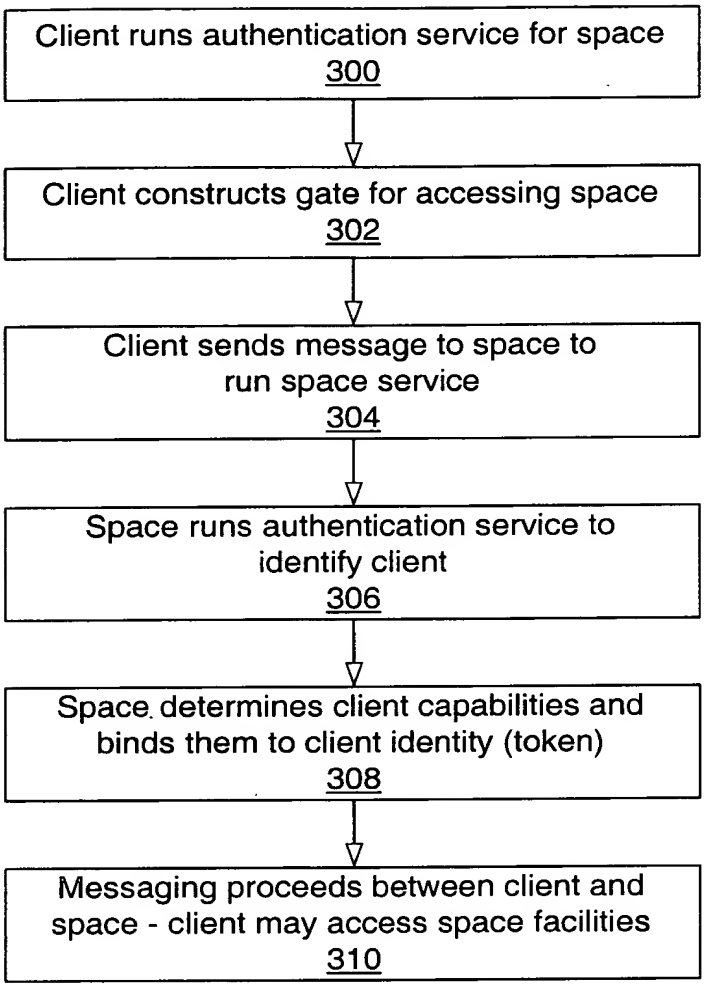

Client runs authentication service for space
300
Client constructs gate for accessing space
302
Client sends message to space to run space service
304
Space runs authentication service to identify client
306
Space determines client capabilities and binds them to client identity (token)
308
Messaging proceeds between client and space - client may access space facilities
310

Fig. 20

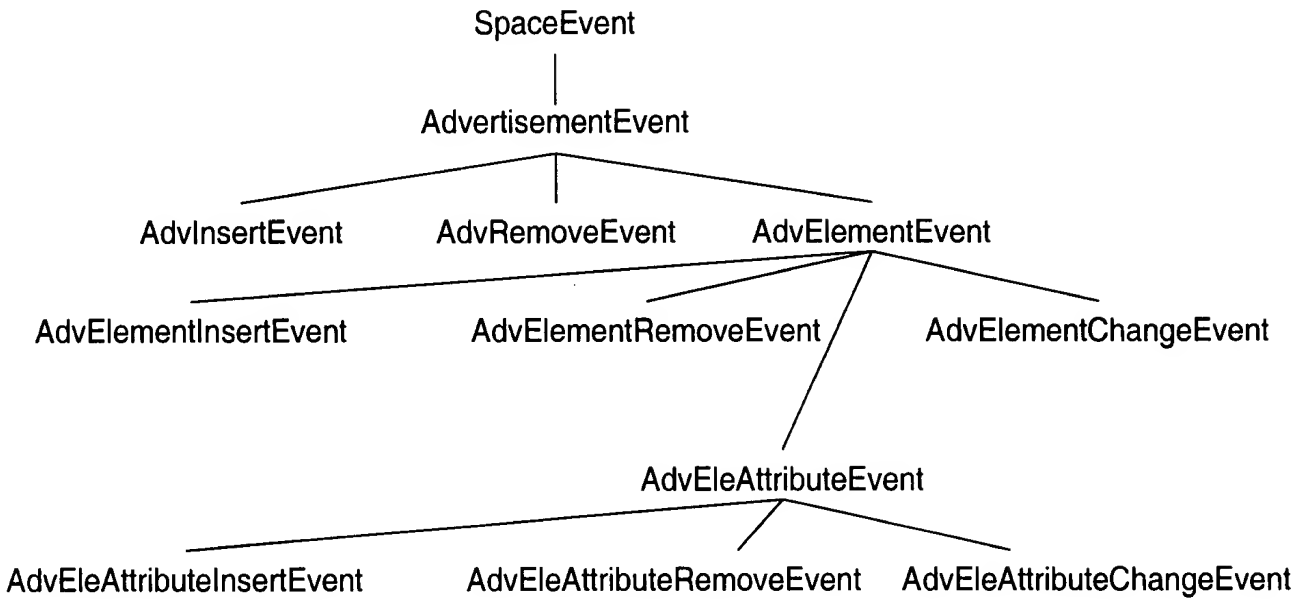

SpaceEvent
AdvertisementEvent
AdvInsertEvent
AdvRemoveEvent
AdvElementEvent
AdvElementInsertEvent
AdvElementRemoveEvent
AdvElementChangeEvent
AdvEleAttributeEvent
AdvEleAttributeInsertEvent
AdvEleAttributeRemoveEvent
AdvEleAttributeChangeEvent

Fig. 21

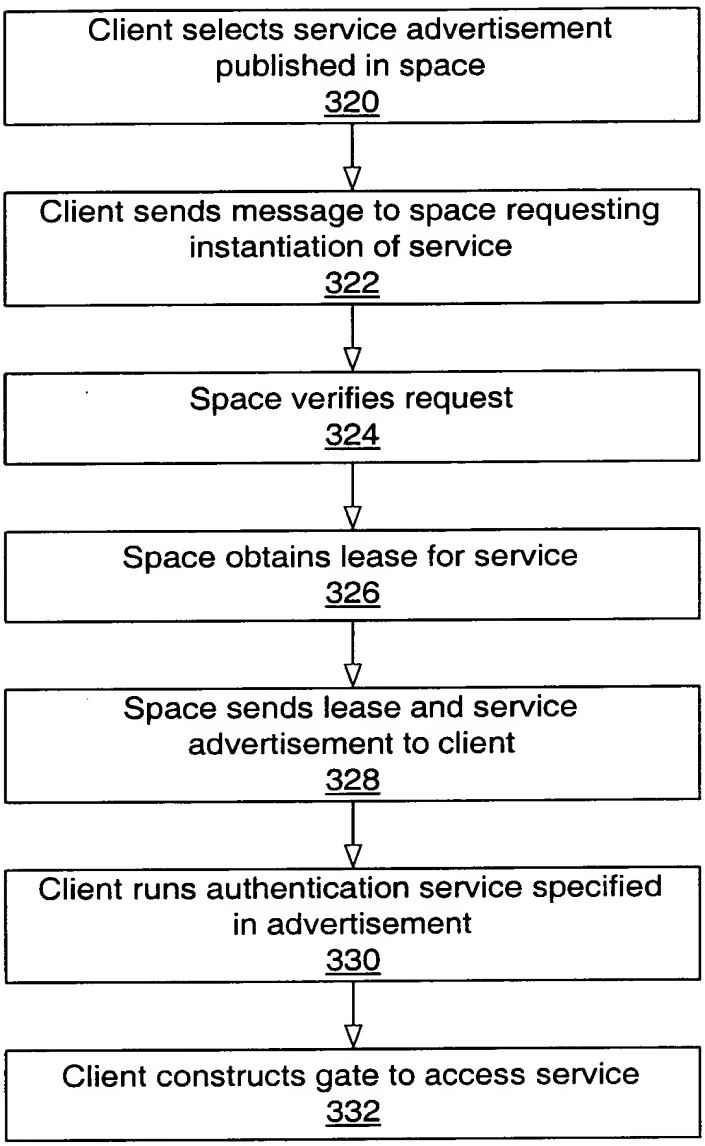

Client selects service advertisement published in space
320
Client sends message to space requesting instantiation of service
322
Space verifies request
324
Space obtains lease for service
326
Space sends lease and service advertisement to client
328
Client runs authentication service specified in advertisement
330
Client constructs gate to access service
332

Fig. 22

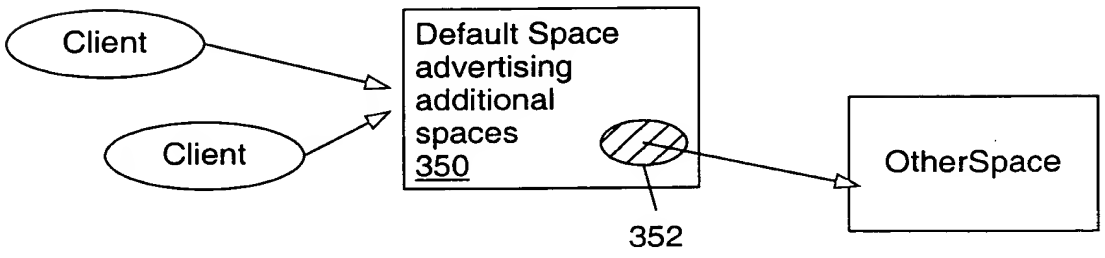

Client
Client
Default Space advertising additional spaces
350
352
OtherSpace

Fig. 23

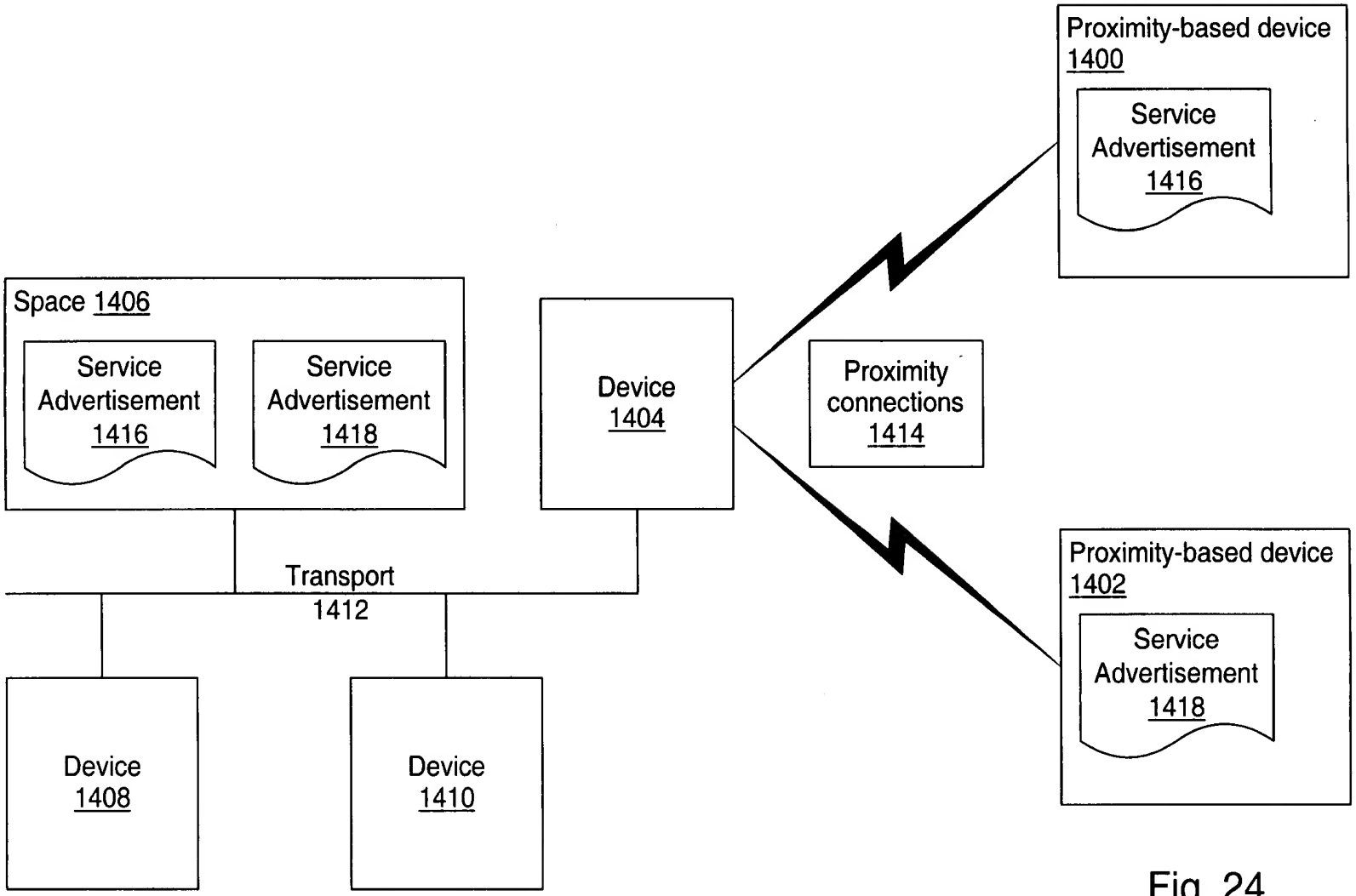

Proximity-based device
1400
Service
Advertisement
1416
Space 1406
Service
Advertisement
1416
Service
Advertisement
1418
Device
1404
Proximity
connections
1414
Transport
1412
Proximity-based device
1402
Service
Advertisement
1418
Device
1408
Device
1410

Fig. 24

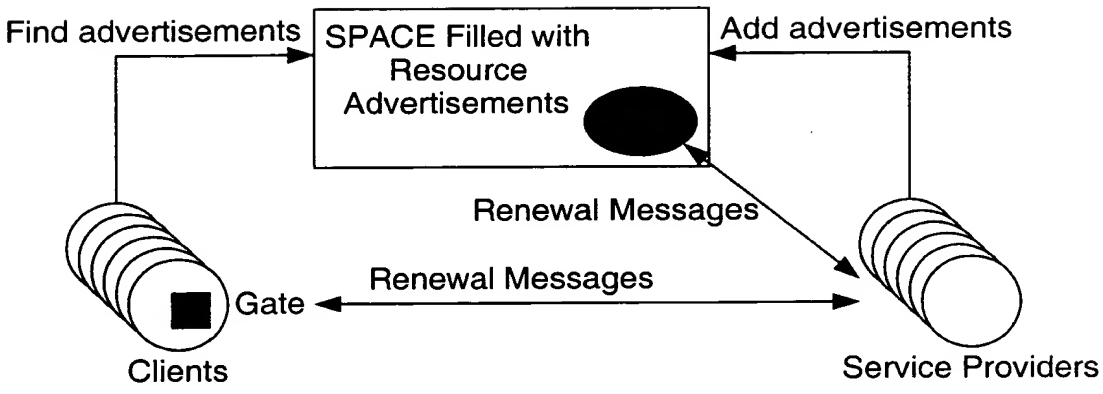

Find advertisements
SPACE Filled with Resource Advertisements
Add advertisements
Renewal Messages
Renewal Messages
Gate
Clients
Service Providers

Fig. 25

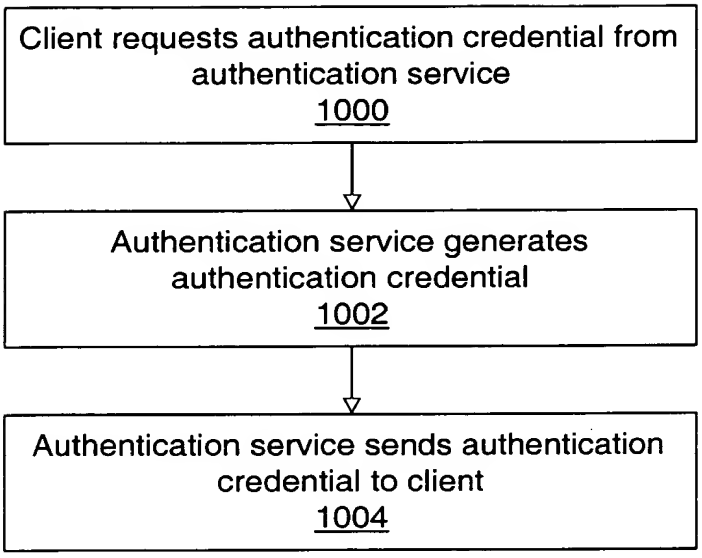


FIG. 26a

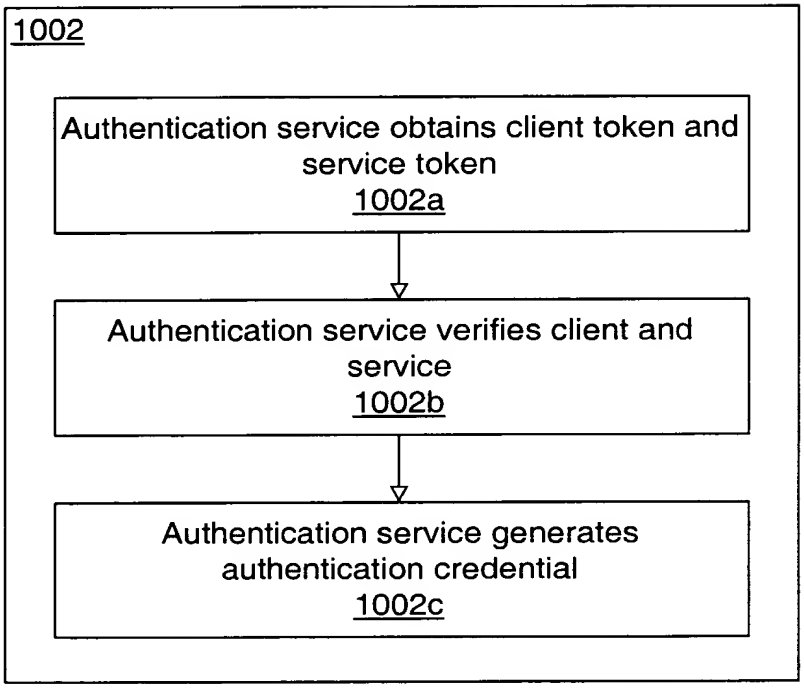


FIG. 26b

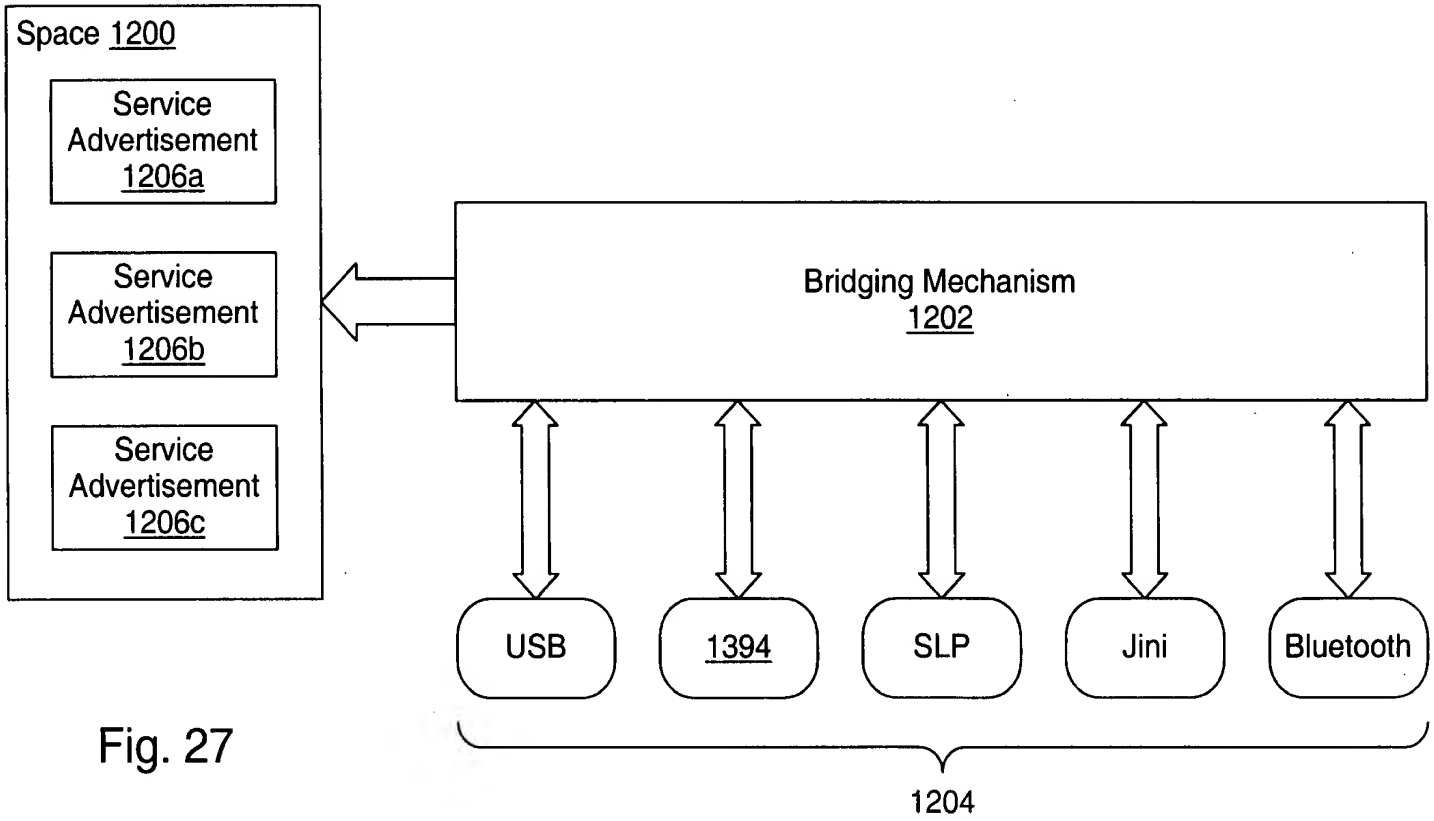

Space 1200
Service Advertisement 1206a
Service Advertisement 1206b
Service Advertisement 1206c
Bridging Mechanism 1202
USB
1394
SLP
Jini
Bluetooth
1204

Fig. 27

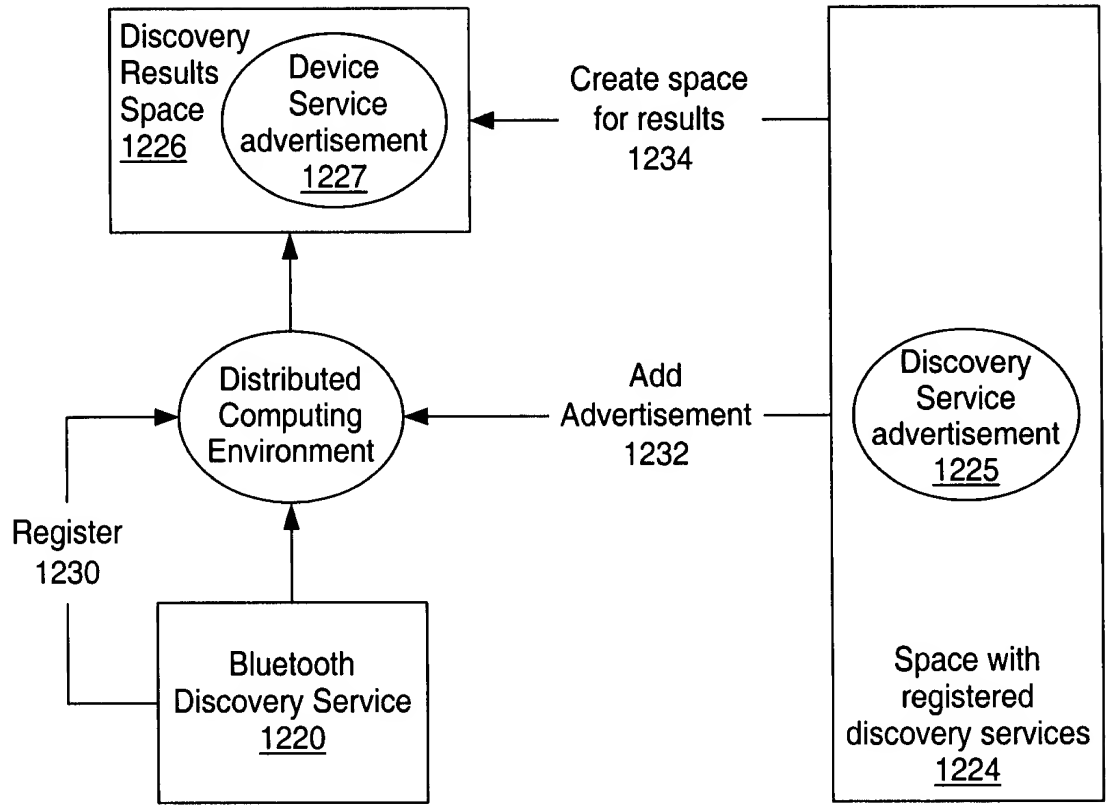
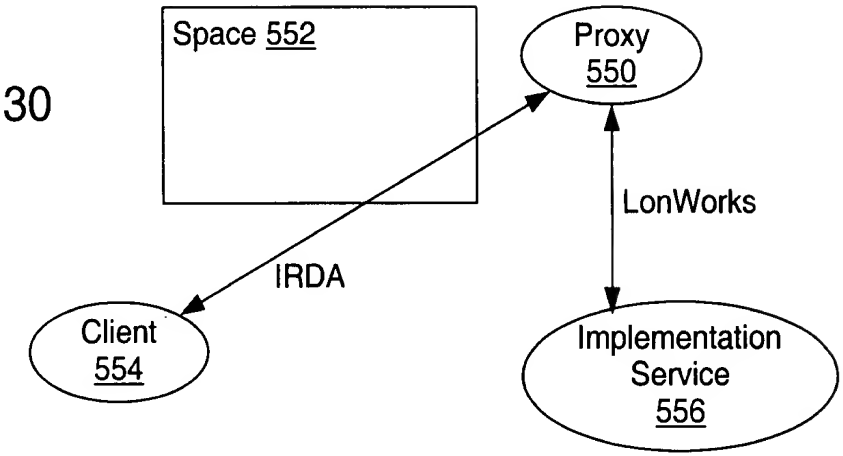

Discovery Results Space 1226
Device Service advertisement 1227
Create space for results 1234
Distributed Computing Environment
Add Advertisement 1232
Discovery Service advertisement 1225
Register 1230
Bluetooth Discovery Service 1220
Space with registered discovery services 1224

Fig. 28

Fig. 30


Space 552
Proxy
550
LonWorks
IRDA
Client
554
Implementation
Service
556

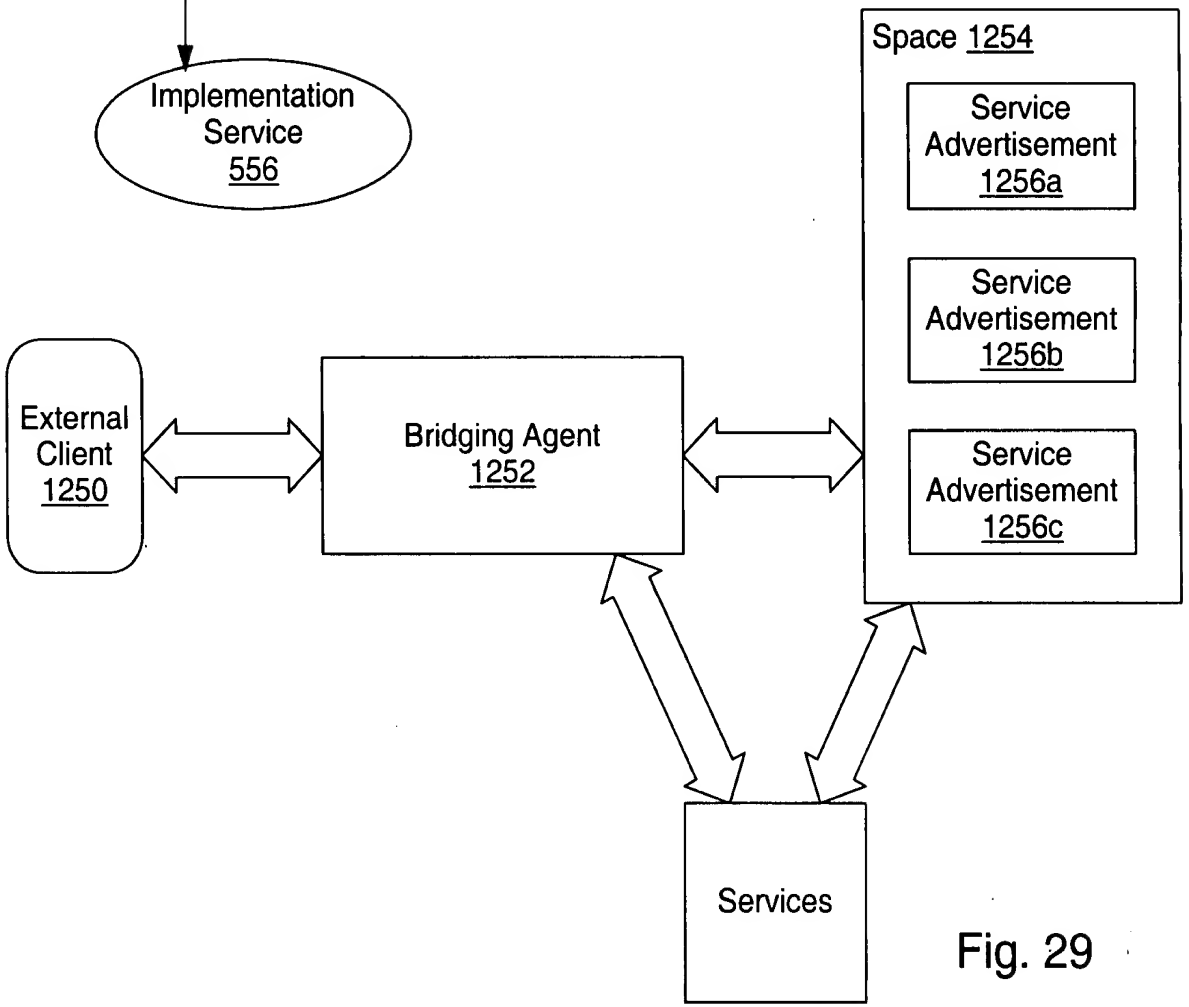

Space 1254
Service
Advertisement
1256a
Service
Advertisement
1256b
Service
Advertisement
1256c
External
Client
1250
Bridging Agent
1252
Services

Fig. 29

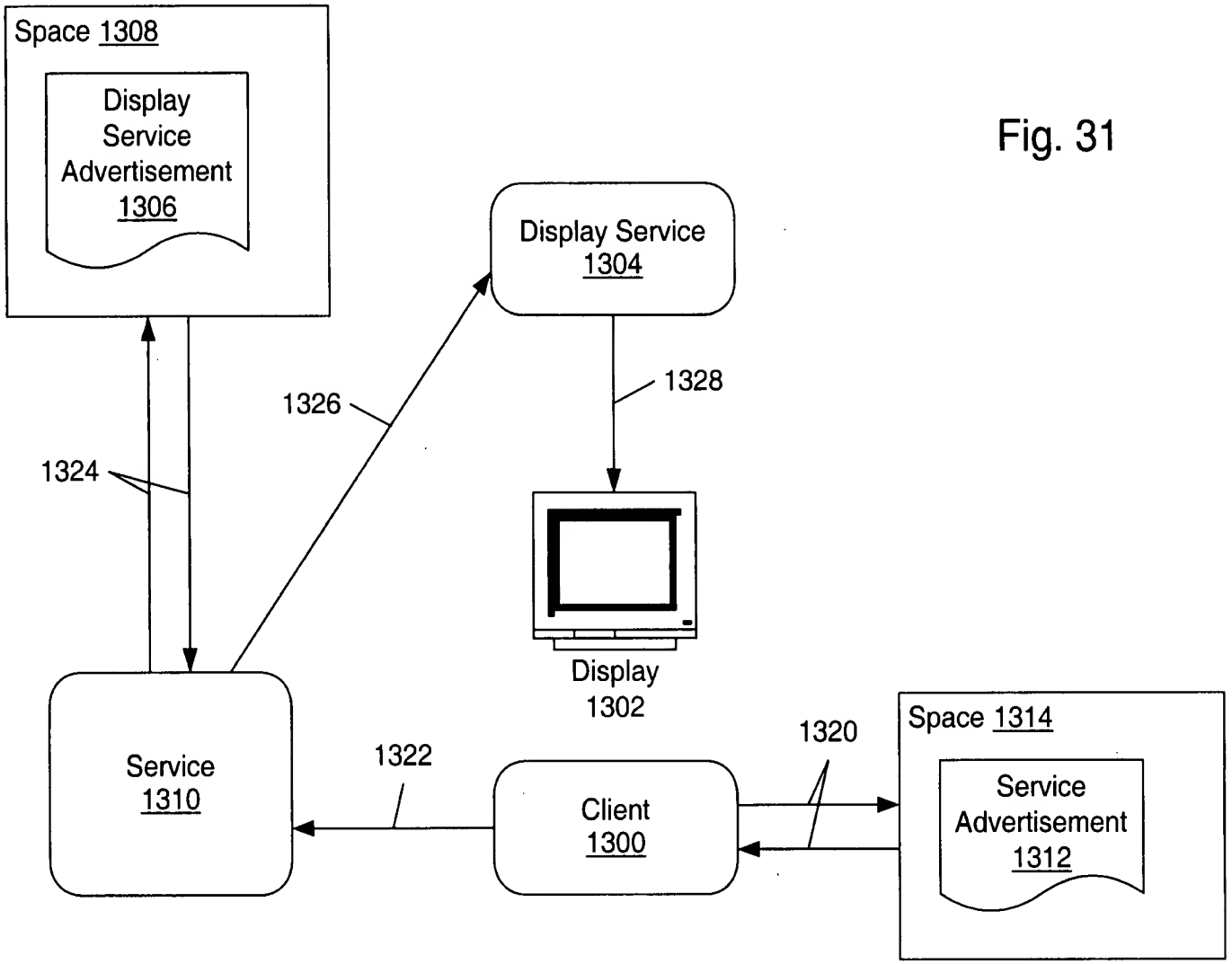

Space 1308
Display Service Advertisement 1306
Display Service 1304
1326
1328
1324
Display 1302
Service 1310
1322
Client 1300
1320
Space 1314
Service Advertisement 1312

Fig. 31

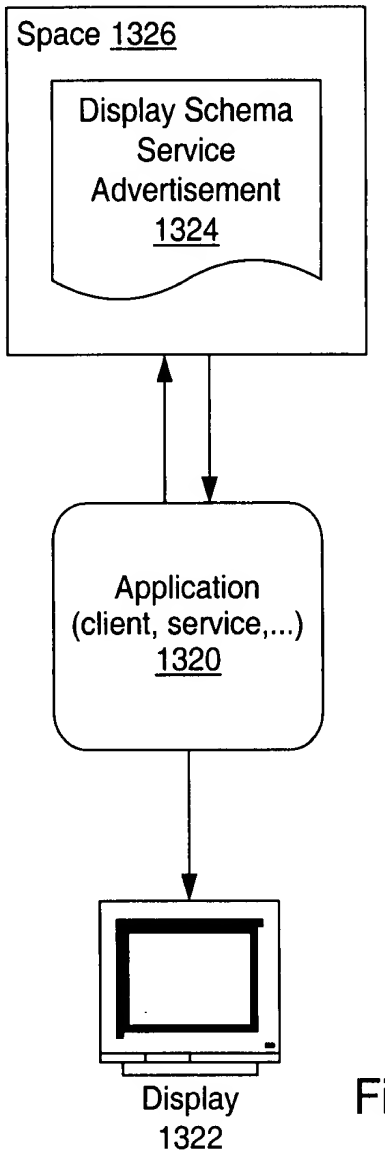


Fig. 32A

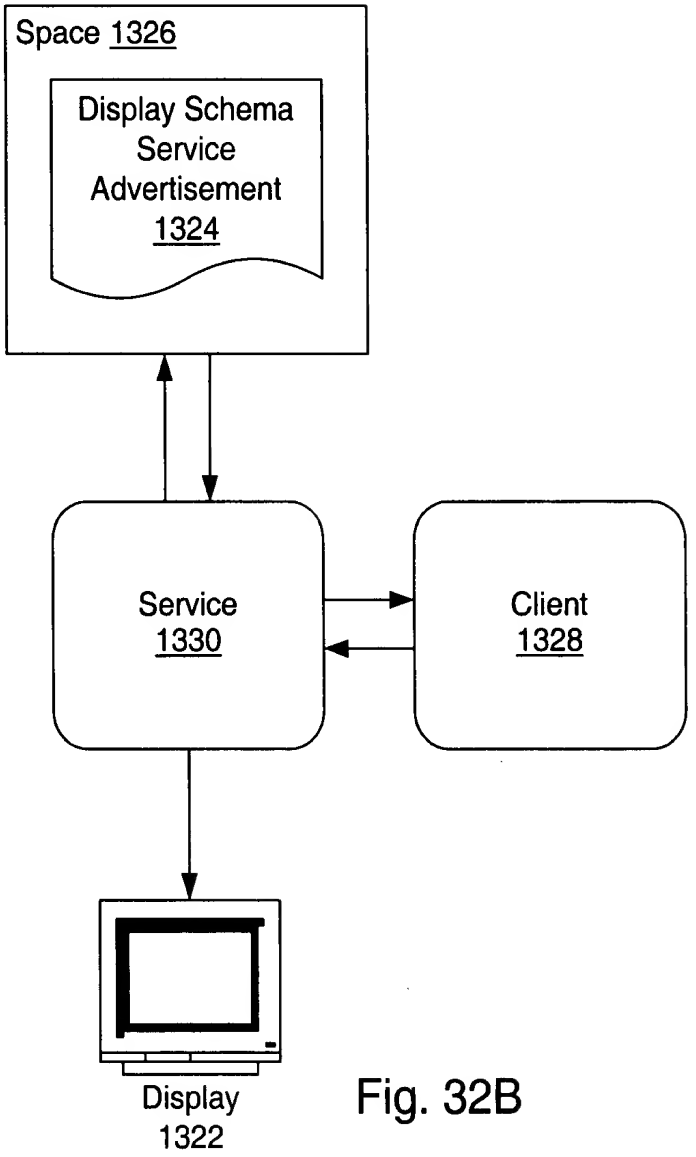


Fig. 32B

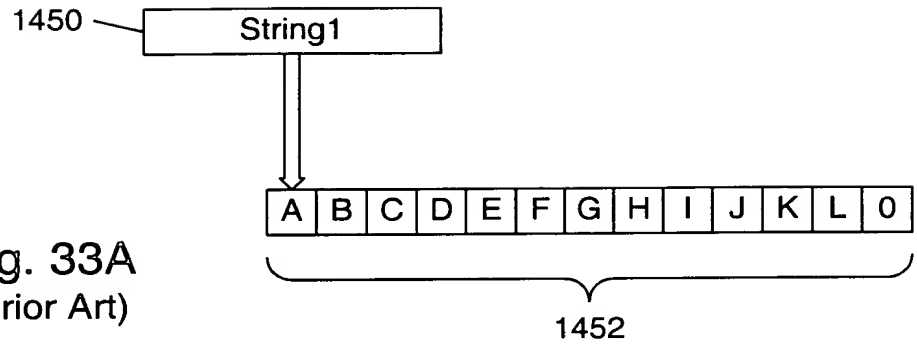


Fig. 33A
(Prior Art)

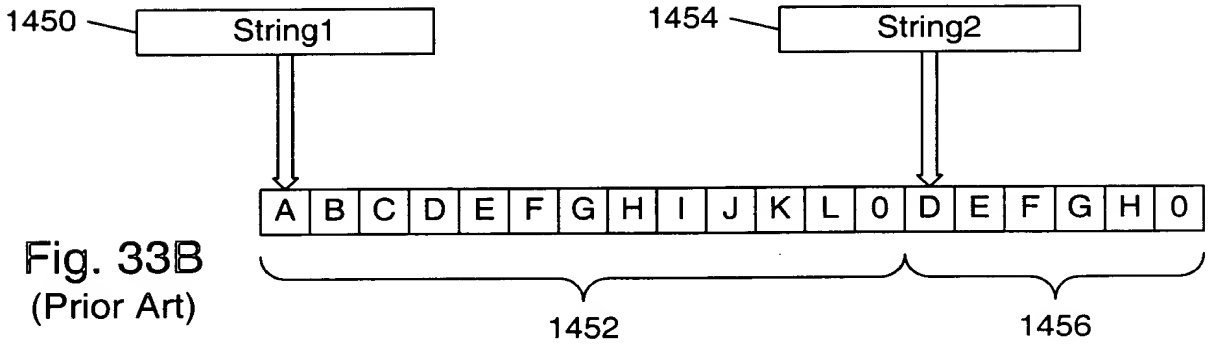


Fig. 33B
(Prior Art)

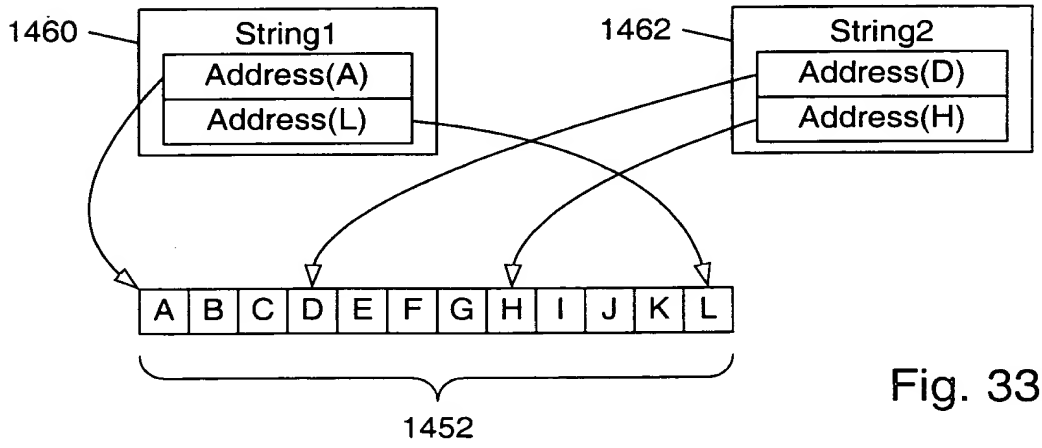


Fig. 33C

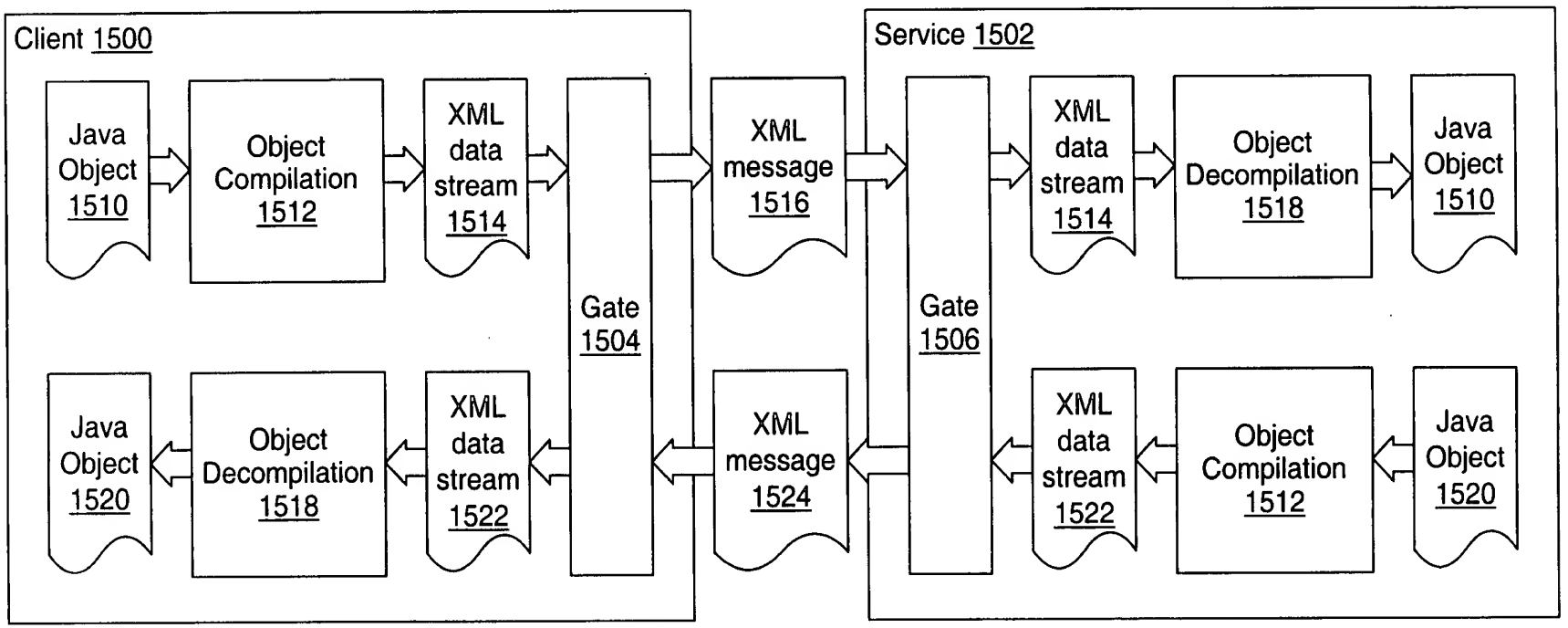

Client 1500
Java Object 1510
Object Compilation 1512
XML data stream 1514
Gate 1504
XML message 1516
Service 1502
Gate 1506
XML data stream 1514
Object Decompilation 1518
Java Object 1510
Java Object 1520
Object Decompilation 1518
XML data stream 1522
XML message 1524
XML data stream 1522
Object Compilation 1512
Java Object 1520

Fig. 34

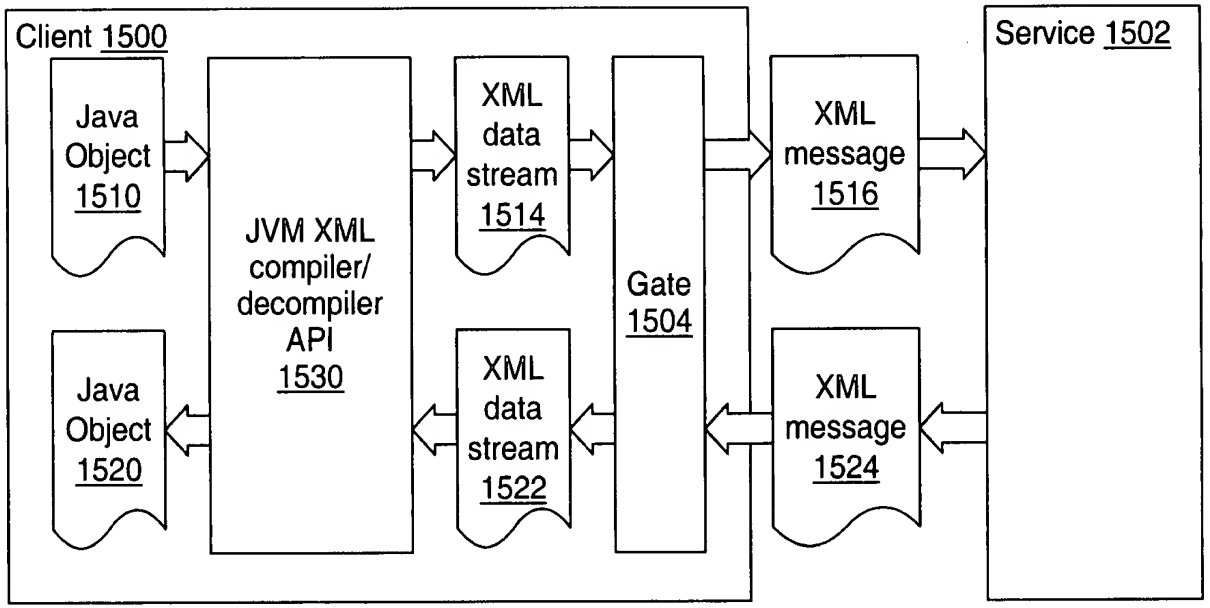


Fig. 35a

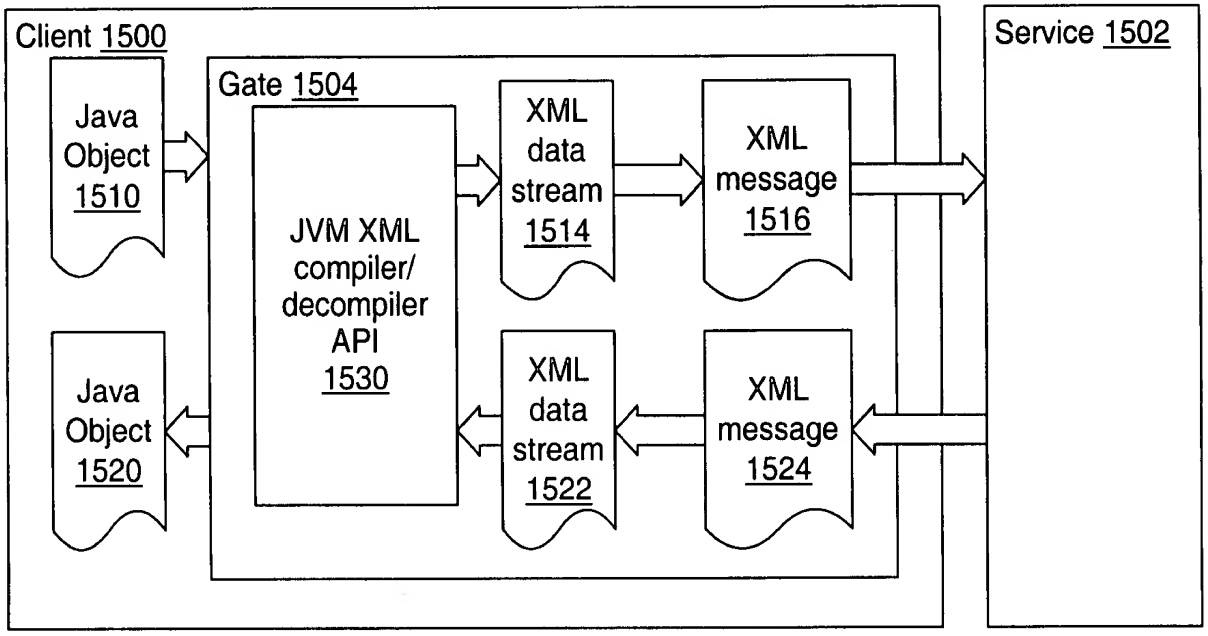


Fig. 35b

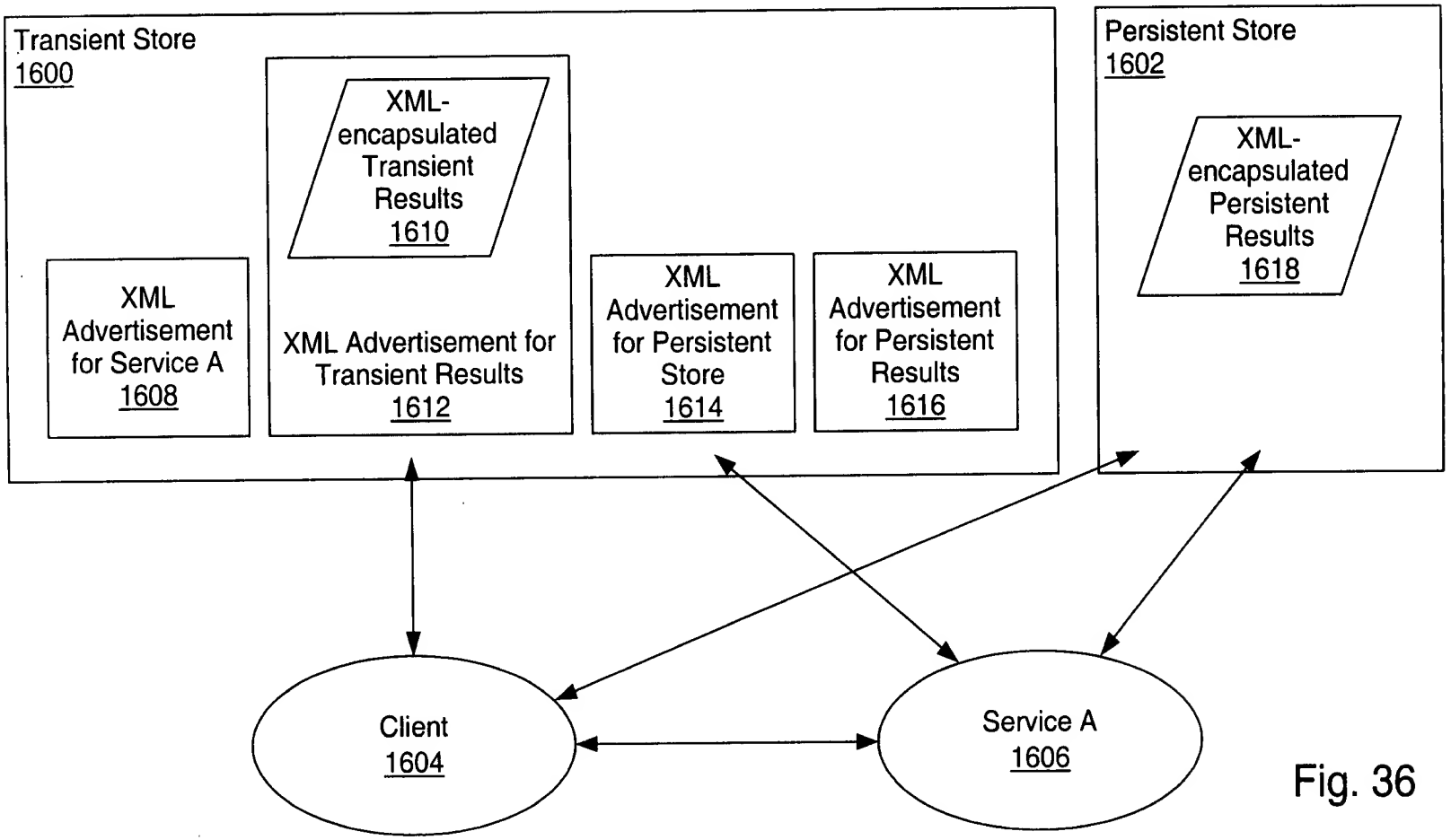

Transient Store
1600
XML-encapsulated Transient Results
1610
XML Advertisement for Service A
1608
XML Advertisement for Transient Results
1612
XML Advertisement for Persistent Store
1614
XML Advertisement for Persistent Results
1616
Persistent Store
1602
XML-encapsulated Persistent Results
1618
Client
1604
Service A
1606

Fig. 36

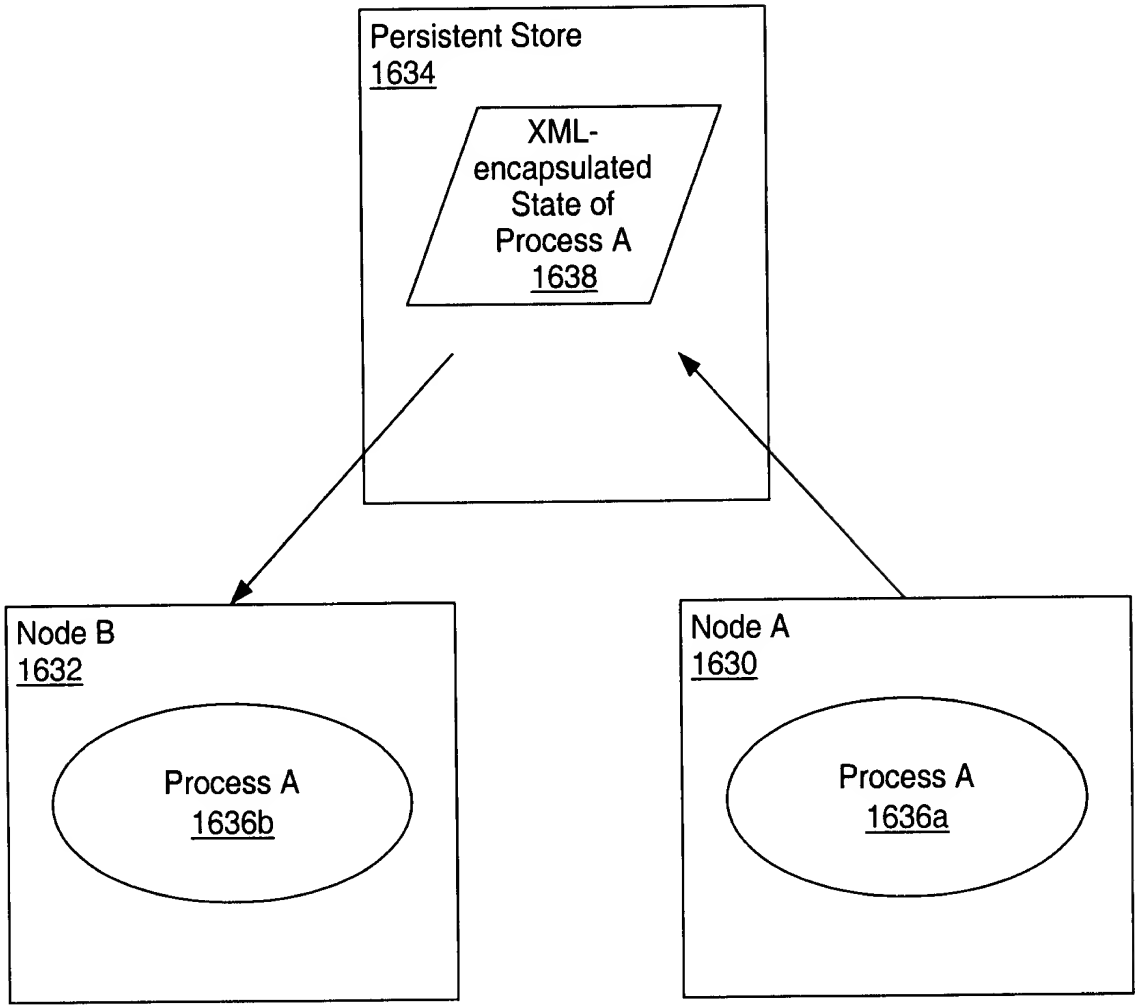

Persistent Store
1634
XML-
encapsulated
State of
Process A
1638
Node B
1632
Process A
1636b
Node A
1630
Process A
1636a

Fig. 37

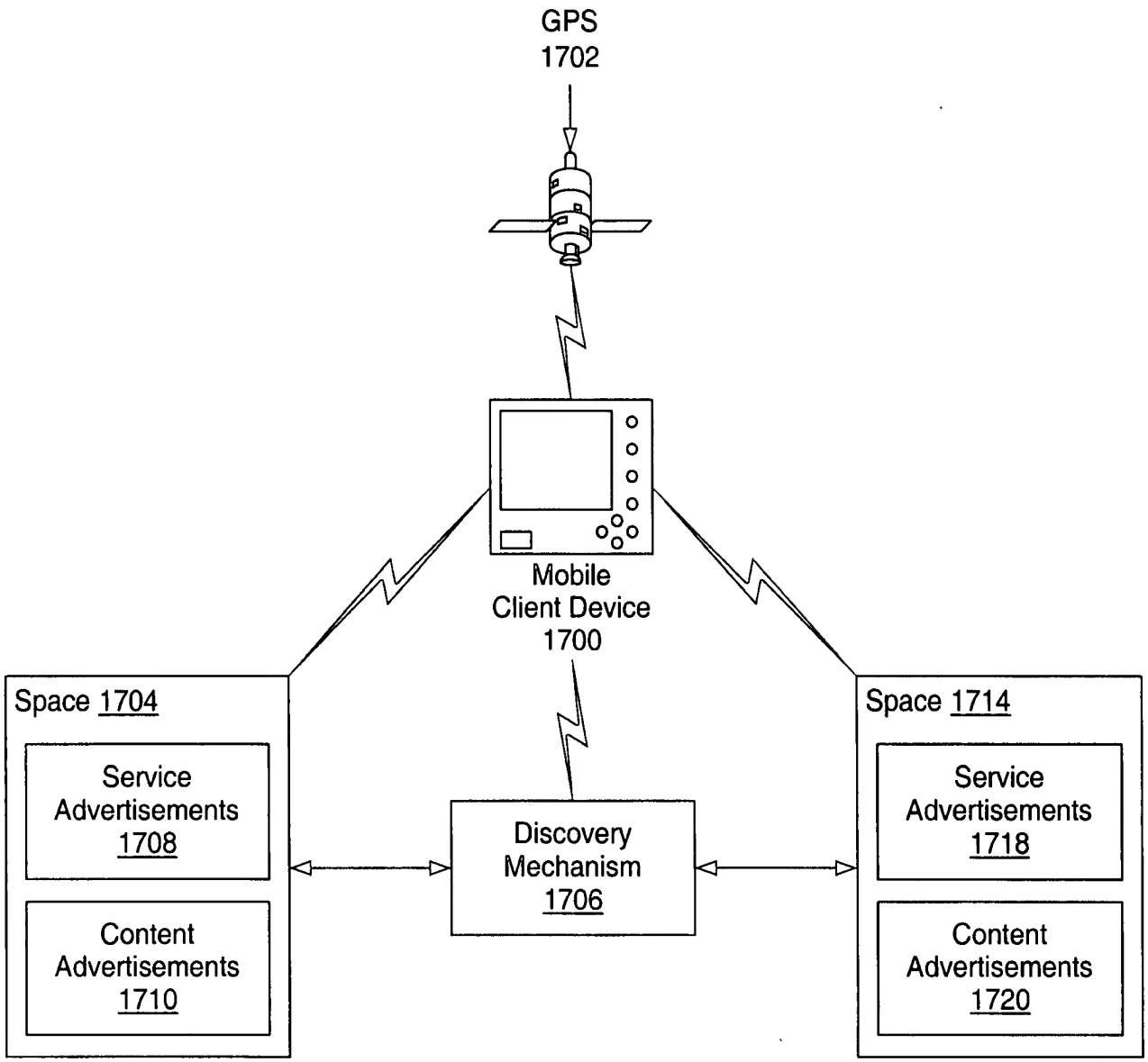

GPS
1702
Mobile
Client Device
1700
Space 1704
Service
Advertisements
1708
Content
Advertisements
1710
Discovery
Mechanism
1706
Space 1714
Service
Advertisements
1718
Content
Advertisements
1720

Fig. 38

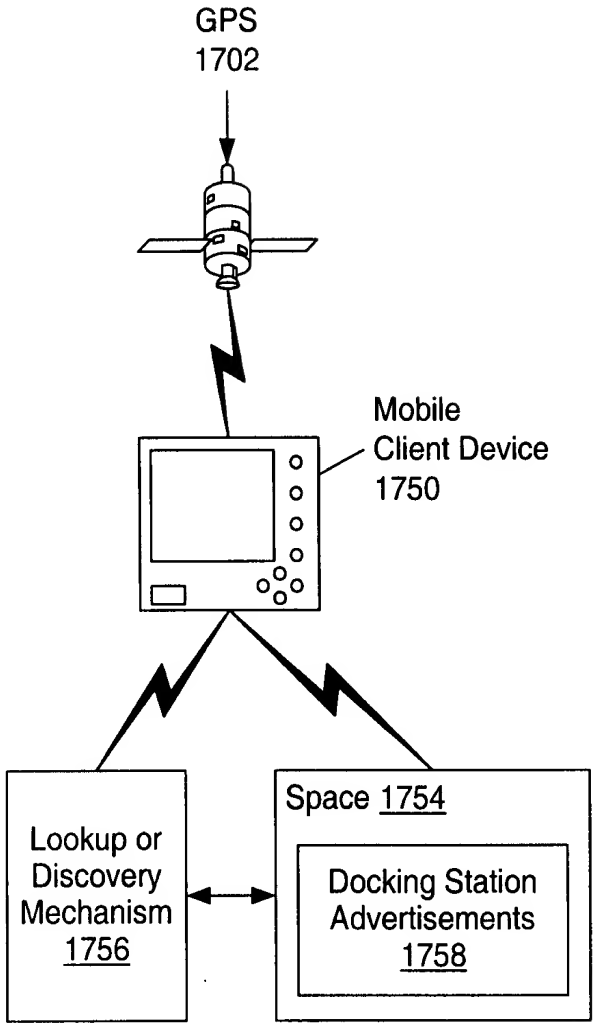


Fig. 39a

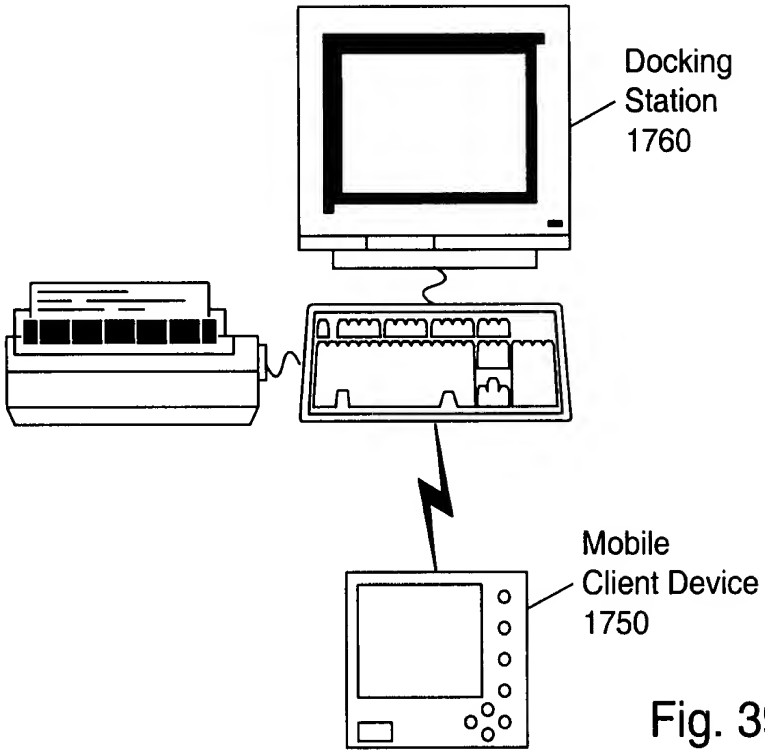


Fig. 39b

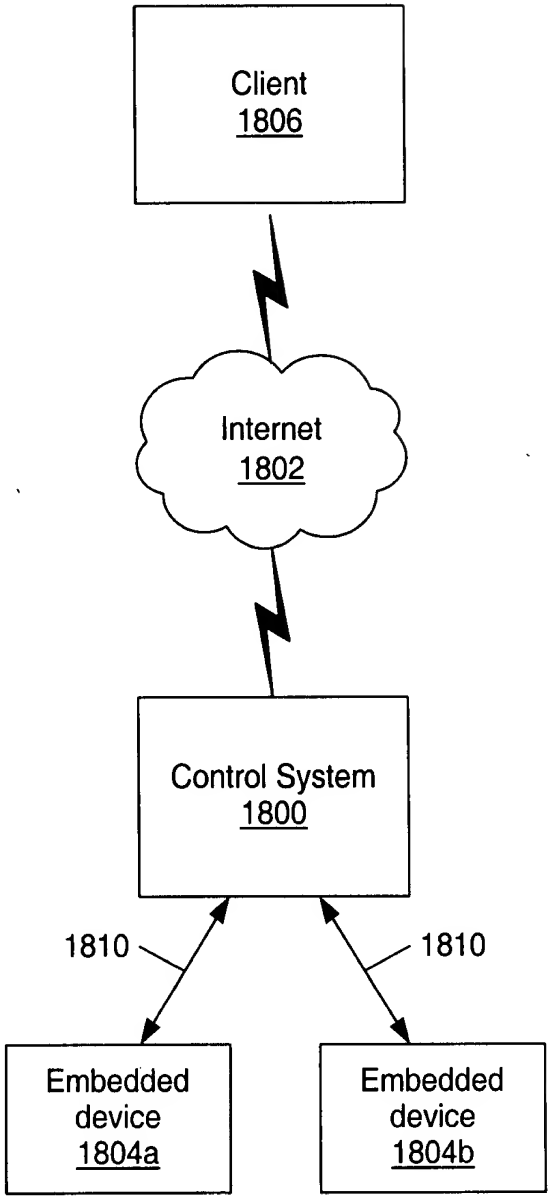


Fig. 40a

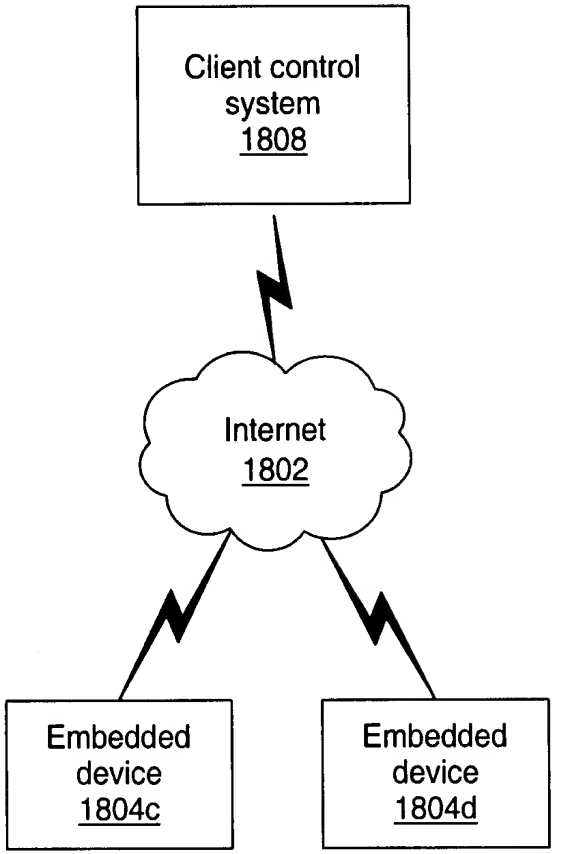


Fig. 40b

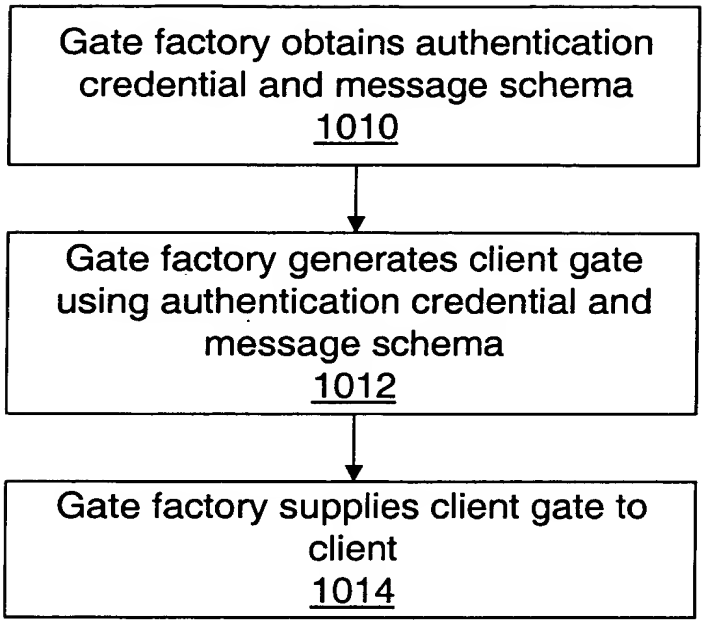

Gate factory obtains authentication credential and message schema
1010
Gate factory generates client gate using authentication credential and message schema
1012
Gate factory supplies client gate to client
1014

FIG. 41

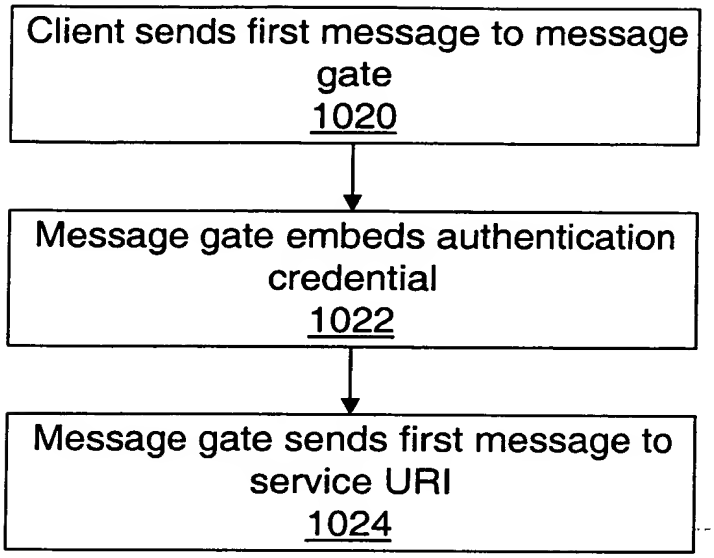


FIG. 42a

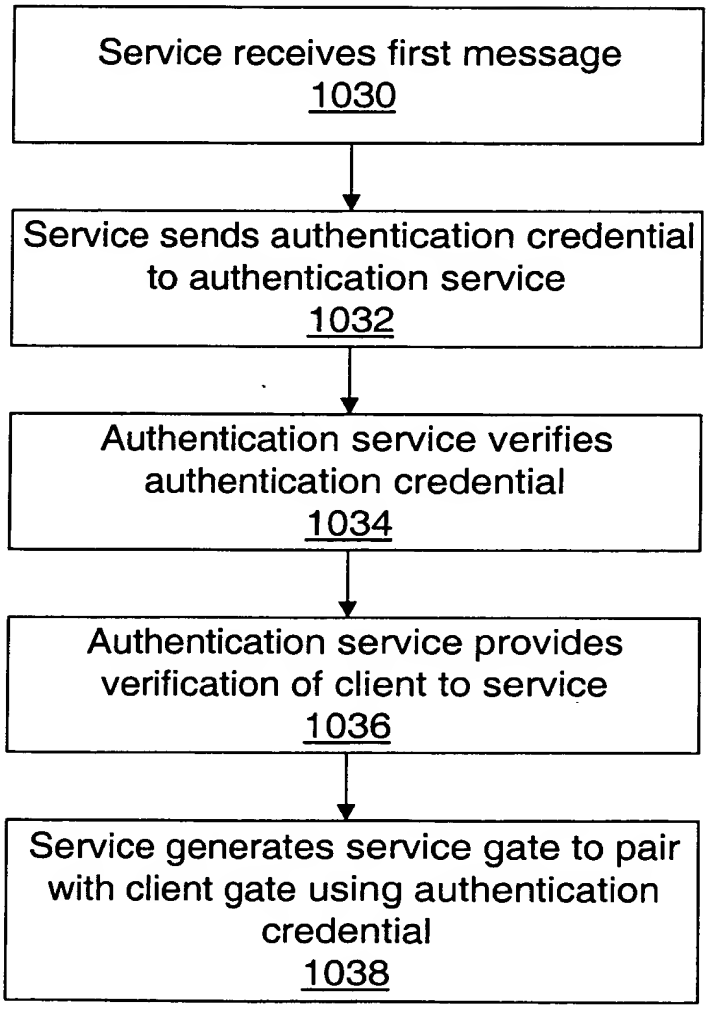


FIG. 42b

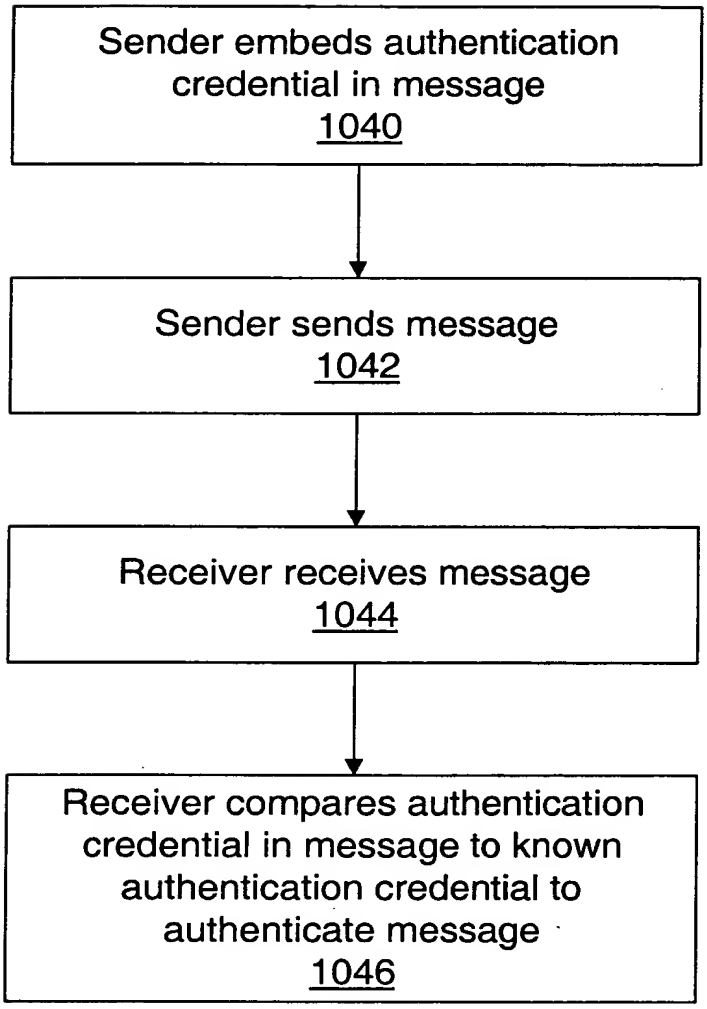

Sender embeds authentication credential in message
1040
Sender sends message
1042
Receiver receives message
1044
Receiver compares authentication credential in message to known authentication credential to authenticate message
1046

FIG. 42c

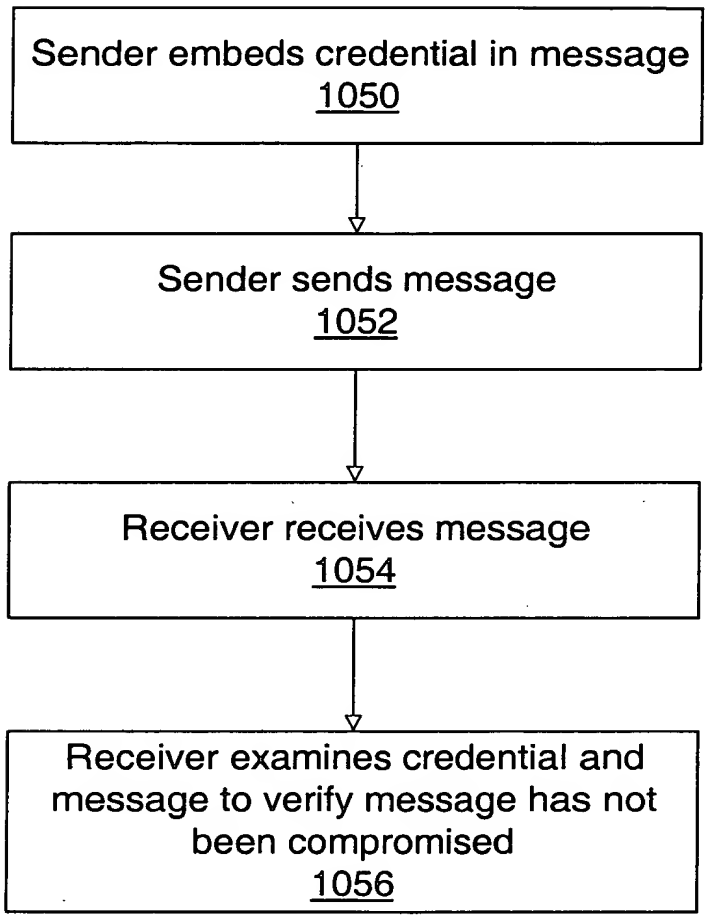

Sender embeds credential in message
1050
Sender sends message
1052
Receiver receives message
1054
Receiver examines credential and message to verify message has not been compromised
1056

FIG. 43

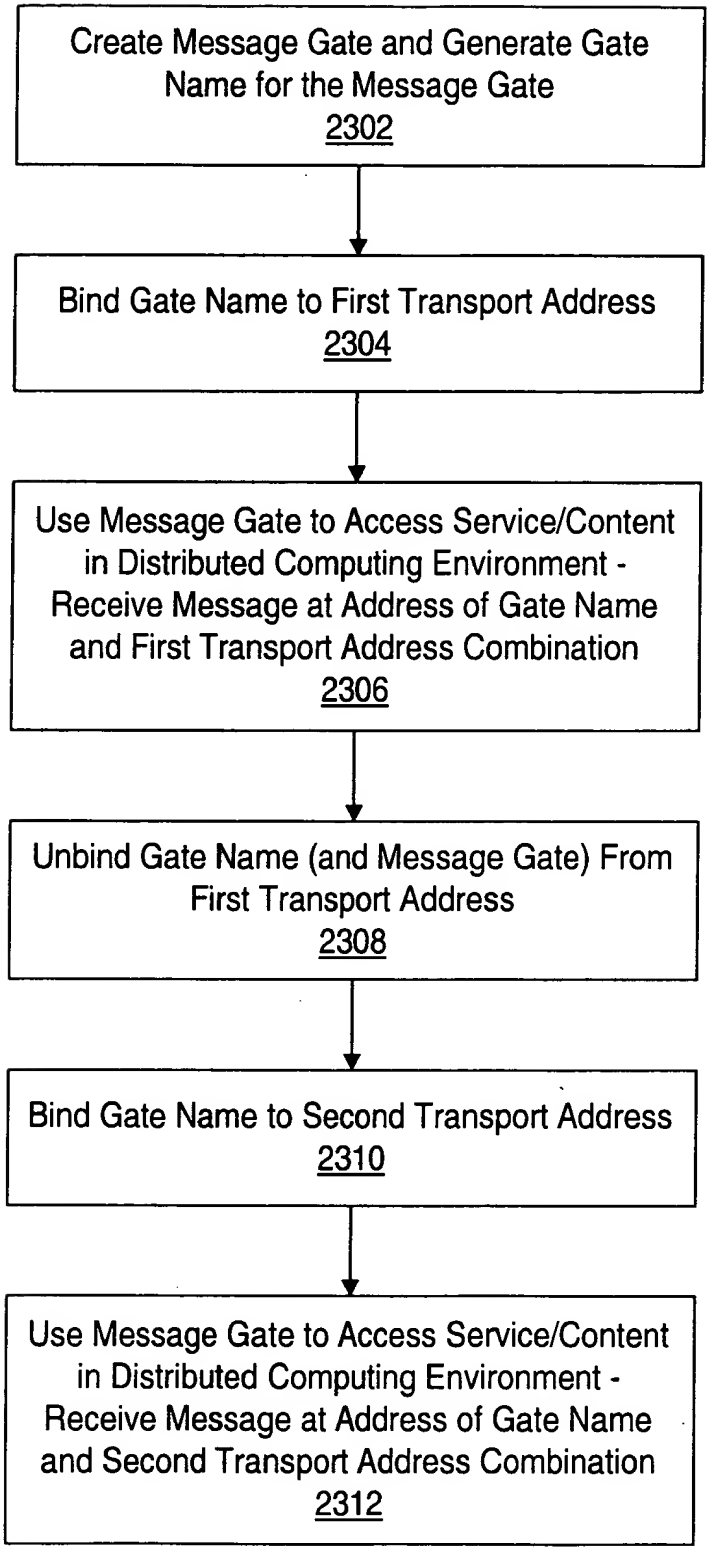

Create Message Gate and Generate Gate Name for the Message Gate
2302
Bind Gate Name to First Transport Address
2304
Use Message Gate to Access Service/Content in Distributed Computing Environment - Receive Message at Address of Gate Name and First Transport Address Combination
2306
Unbind Gate Name (and Message Gate) From First Transport Address
2308
Bind Gate Name to Second Transport Address
2310
Use Message Gate to Access Service/Content in Distributed Computing Environment - Receive Message at Address of Gate Name and Second Transport Address Combination
2312

FIG. 44

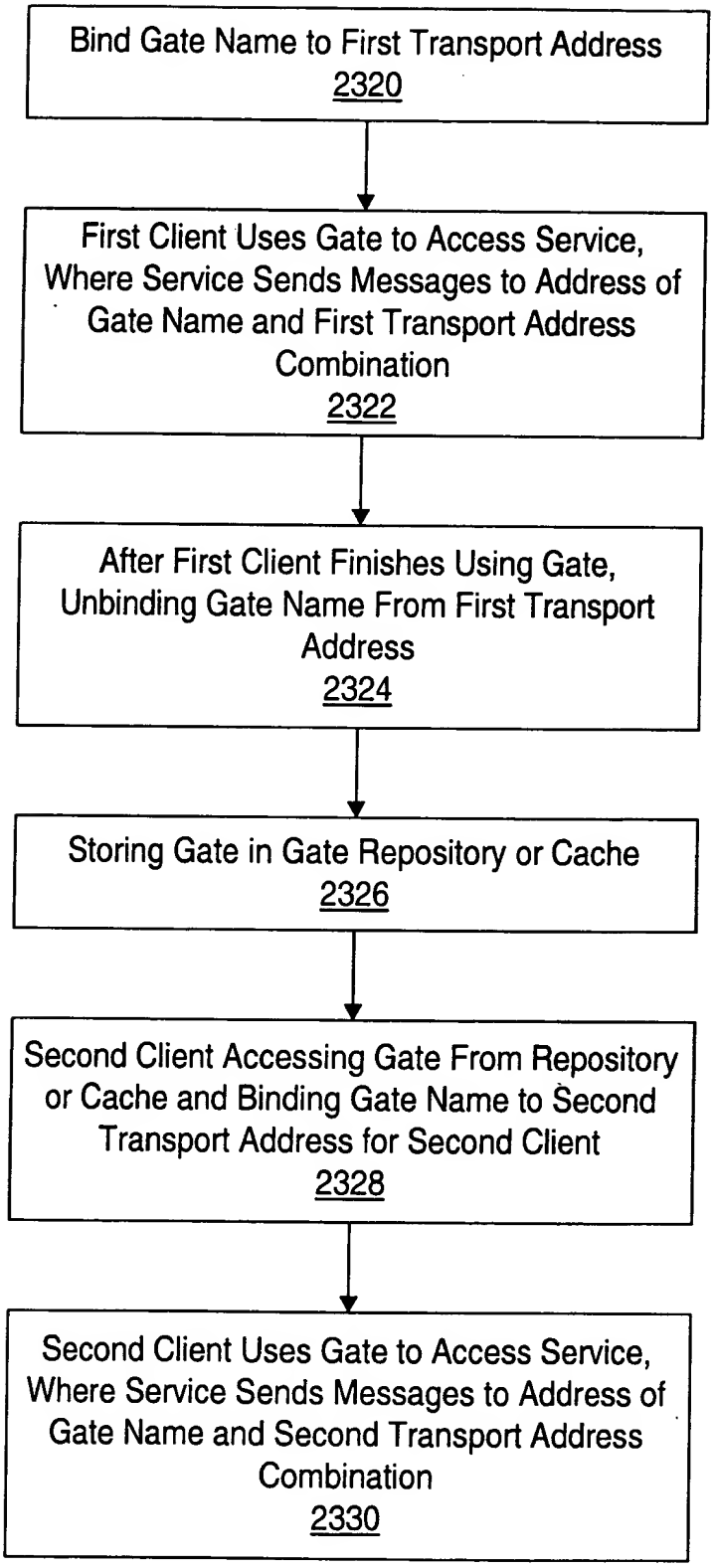

Bind Gate Name to First Transport Address
2320
First Client Uses Gate to Access Service, Where Service Sends Messages to Address of Gate Name and First Transport Address Combination
2322
After First Client Finishes Using Gate, Unbinding Gate Name From First Transport Address
2324
Storing Gate in Gate Repository or Cache
2326
Second Client Accessing Gate From Repository or Cache and Binding Gate Name to Second Transport Address for Second Client
2328
Second Client Uses Gate to Access Service, Where Service Sends Messages to Address of Gate Name and Second Transport Address Combination
2330

FIG. 45

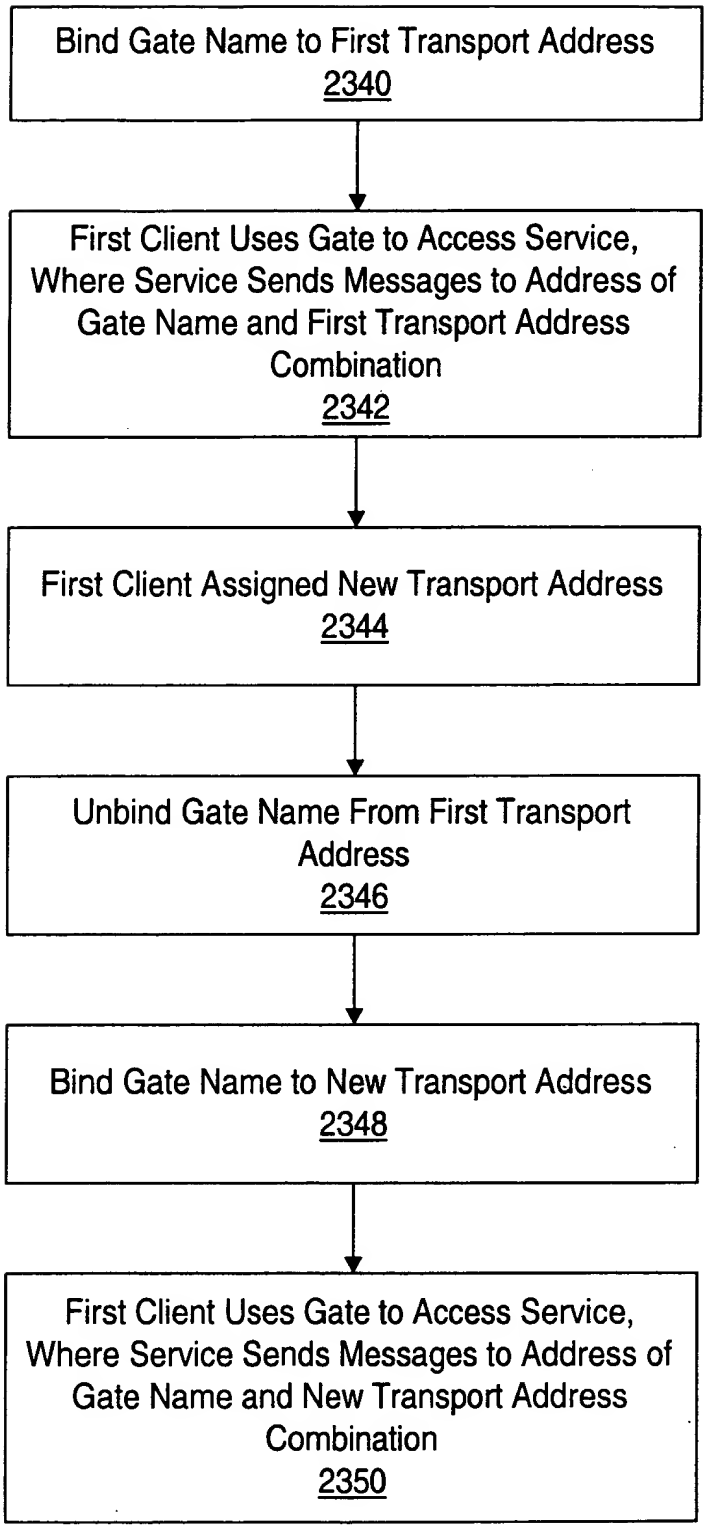

Bind Gate Name to First Transport Address
2340
First Client Uses Gate to Access Service, Where Service Sends Messages to Address of Gate Name and First Transport Address Combination
2342
First Client Assigned New Transport Address
2344
Unbind Gate Name From First Transport Address
2346
Bind Gate Name to New Transport Address
2348
First Client Uses Gate to Access Service, Where Service Sends Messages to Address of Gate Name and New Transport Address Combination
2350

FIG. 46

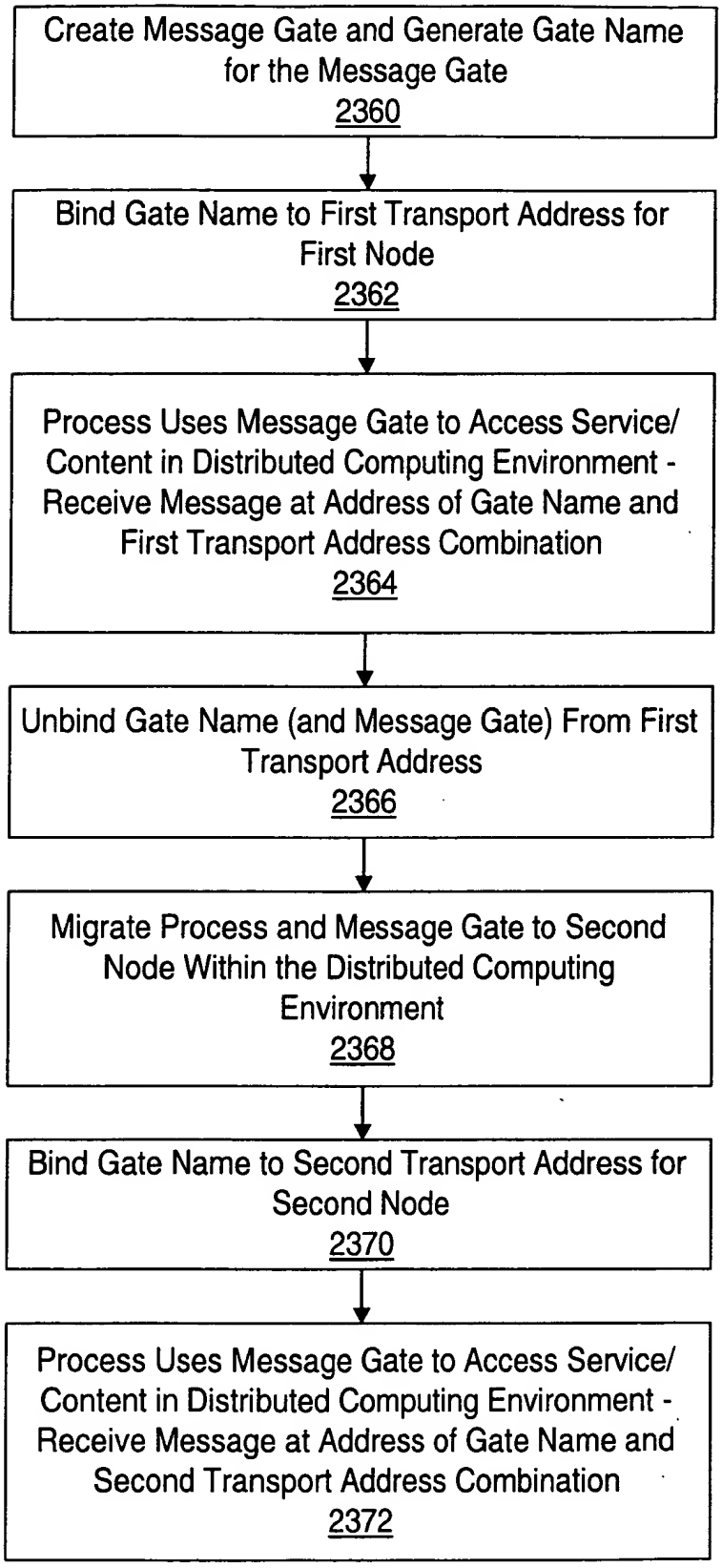

Create Message Gate and Generate Gate Name for the Message Gate
2360
Bind Gate Name to First Transport Address for First Node
2362
Process Uses Message Gate to Access Service/ Content in Distributed Computing Environment - Receive Message at Address of Gate Name and First Transport Address Combination
2364
Unbind Gate Name (and Message Gate) From First Transport Address
2366
Migrate Process and Message Gate to Second Node Within the Distributed Computing Environment
2368
Bind Gate Name to Second Transport Address for Second Node
2370
Process Uses Message Gate to Access Service/ Content in Distributed Computing Environment - Receive Message at Address of Gate Name and Second Transport Address Combination
2372

FIG. 47

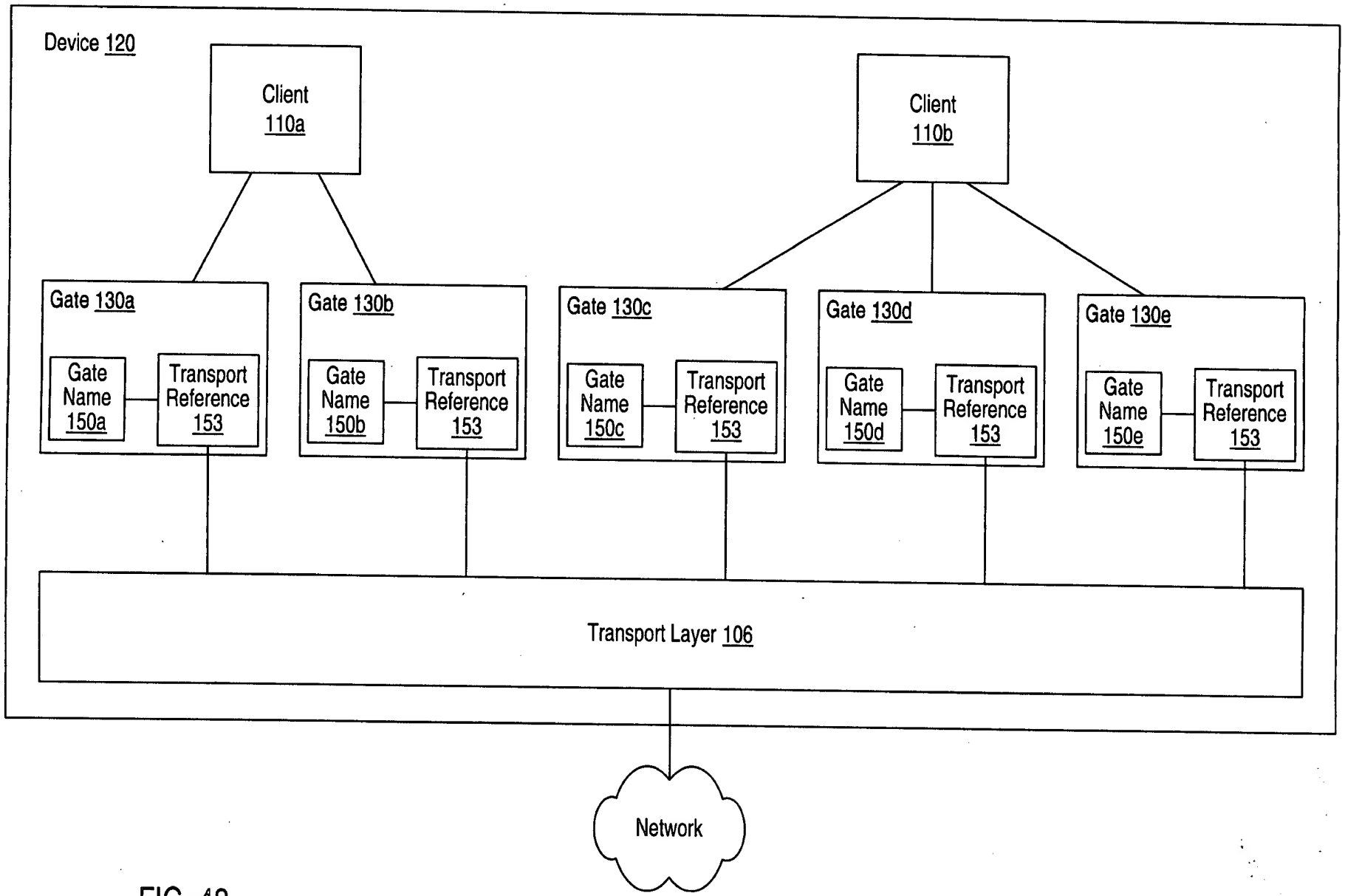

Device 120
Client 110a
Client 110b
Gate 130a
Gate Name 150a
Transport Reference 153
Gate 130b
Gate Name 150b
Transport Reference 153
Gate 130c
Gate Name 150c
Transport Reference 153
Gate 130d
Gate Name 150d
Transport Reference 153
Gate 130e
Gate Name 150e
Transport Reference 153
Transport Layer 106
Network

FIG. 48